CURRENT SCIENCE

Vol. VIII] May 1939 [No. 5

The Indian Institute of Science

SINCE the Irvine Committee reported on the unhappy circumstances which prevailed in the Institute at the time they commenced their labours, the "atmosphere of insecurity and misery", to which they had drawn pointed attention, would appear to have worsened, if the correspondence recently published in the press is credible. In the concluding section of the report, the Committee, almost in a prophetic spirit, made the remark which is at once encouraging and disturbing, that "if given a fair trial and if operated in the right spirit, the proposals will enable the Institute to begin its semi-jubilee period with renewed hope, but if our scheme fails, it can only be through the clash of personalities beyond the remedy of any powers possessed by a Reviewing Committee". We doubt whether the Institute really suffers from any clash of personalities, but we are prepared to admit that there is almost an irreconcilable war of ideals, arising from two academic luxuries which the Institute can hardly afford. The first of them is apparently a body of elderly authorities composing the Governing Council, whose imagination has become by routine administration as rigid as perhaps their arteries on account of their advancing age: the other is a group of ardent young students and members of the staff who, inflated with noble ideals, are impatient to dash forth to win their spurs in extending the frontiers of knowledge. Any school girl who has passed her matriculation examination on common sense will tell us that the former is as dangerous a symptom as the latter is a healthy sign, for a generous enthusiasm and sterling ambition, when wisely harnessed and judiciously directed, must at all times constitute an invaluable asset for the Institute. We need hardly observe that it would be a historic case of wasted opportunity if the zeal of the young men were compelled to lie fallow or interpreted as synonymous with aggressive spirit.

We have no access to the confidential documents of the Council. No responsible officer of the Institute has disclaimed the statements made in the press, impugning the principles and policies underlying the recent proceedings of the Governing Council. Where, however, one party resorts to the press and the other remains passive, it is natural to assume that the public statements may in some measure be vitiated by exaggeration of the actual state of affairs. In spite of such dubious circumstances, it seems perfectly legitimate to offer some comments on the real issue, lurking behind this superficial and unnecessary controversy, the issue whether the affairs of the Institute are to be conducted on the basis of objective reality or on the strength of emotional convictions, whose source must at all times remain extremely suspect.

The appointment of Sir Venkataraman in the first instance as Director, and later as Professor of Physics, amounts almost to an epic episode in the annals of the Institute. Having perpetrated this act and as a necessary consequence, the Governing Council should have recognised the wisdom of taking the only logical course of inviting a number of Venkataramans to occupy the professorial chairs of other departments, so as to establish a balance of scientific power and a healthy competition among them on perfectly equal terms. If anything is clear in this complicated world, it is clear that administrators are profoundly ignorant of the modern teachings of folklore and human psychology, and failure to appreciate the truth of the maxim that an academic institution is as weak as its strongest member of the staff, inevitably led the Irvine Committee to record that they were confronted at the outset of their task with issues involving the personal relationships between the Director and the Staff, imposing upon them the undesirable necessity of investigating "the disquieting state of affairs".

On the subject of Staff the Sewell Committee reported as follows in 1931:

"Whatever developments take place in the Universities, we are convinced that with the resources at its disposal, this Institute ought always to be in a position to supply such opportunities for training as cannot be obtained anywhere else in India. This Institute shoud do what no other institution can do. It should maintain a position of pre-eminence: it should acquire a national, even a world reputation: it should become a place of reference. In order that the Institute may maintain such a reputation, two matters are in our opinion of the highest importance. We have occasion in more than one place in this report to draw attention to the ignorance of the work of the Institute which apparently prevails. But we now propose to deal with a second factor, on which the reputation of the Institute greatly depends,

"We refer to the personnel of the Directorate, professoriate and staff. It is a well-known fact that, in more cases than one, the reputation of a University has been built up round the work of some pre-eminent man. Students are attracted by the reputation of the man under whom they hope to work, rather than by any particular virtue of the University itself. A Nernst or a Ramsay would draw men to any institution to which he happened to be attached. We are of the opinion that the chairs in the Institute should be filled by men of the highest eminence, irrespective of nationality, and we recommend therefore, that the terms of appointment be made sufficiently favourable to attract such men."

In 1936 the Irvine Committee remarked as follows on the work of certain departments:

"Some research of sound quality has been carried out, but much of it would come appropriately within the programme of investigations carried out in the Universities for a first research degree."

It is appropriate in the light of these observations to enquire whether or not the administration of the Governing Council during the five years intervening between the two Committees, had started the Institute on a process of retrogressive metamorphosis, resulting in its emergence as a University attempting work of the M.Sc. standard. It will be useful in this connection to remember that most of the scholars coming to the Institute for inspiration and guidance in higher researches, have already obtained the M.Sc. degree, and a fairly large number, the Doctorate degree of Universities enjoying a high academic reputation. Commenting on the future expansion of the Institute, the Sewell Committee observed that "students prior to their admission to the Institute have already received a high degree of training, and in many cases have been initiated into the methods of research in their Universities". Regarding the quality of training to be provided in the Institute, the Pope Committee observed that "it is highly desirable that men trained in the Institute should be eligible for appointment to the professorial staff in due course". Having these illuminating documents before them and manifestly hungering for stimulating inspiration and competent guidance, the junior members of the staff and the scholars desire the Governing Council to take appropriate and urgent steps for the fulfilment of the recommendations regarding the work of the departments and the recruitment of professors made by the authoritative Reviewing and Special Committees.

Judging by the statements published in the press, we are inclined to the opinion that the main problem, occupying the minds of scholars and the members of the staff, seems to be a determined desire to possess Nernsts and Ramsays among them, and naturally when they feel that their reasonable wish is not likely to be realised, they resort to all the constitutional methods open to them for redressing their wants. We have infinite confidence in the sincerity and good faith of the Governing Council, consisting of distinguished scientists, eminent educationists, recognised leaders of public opinion and mature administrators, who have undoubtedly the well-being and prosperity of the Institute nearest to their hearts, but, all the same, having regard to the uniformly impartial treatment accorded to the authoritative pronouncements of all the Committees, respecting the status of the Institute, the qualifications and the breadth of outlook on the part of professors and the range, and quality of scientific work to be initiated and pursued by the superior staff and scholars, we are afraid we cannot rely too confidently on the stability of the mental institution of the Council. It is a well-known psychological fact that almost as a rule when we are compelled to be sensible about working actions, our mind does not necessarily ensure during the same period perfect rationality. It is equally true that administration is a human invention whose treachery is capable of making the admitted virtues of any system a convenient excuse for indulging its vices; for the boldest among us must often shrink from the mental discomfort which is the only reward accruing from our capacity to face truth, though admittedly one of the greatest virtues. We emphasize that the central aim of the Governing authorities of the Institute should definitely tend to reduce the unreasoning fear in its alumni and the unconscious tension in the members of the staff, and this can be achieved only if they give a high-minded attention to all their wants, leaving none of them in an acutely explosive state.

Prior to 1931, the existence of the Indian Institute of Science was known only to the favoured professors and students working in its departments, and probably to those distinguished members who sat in the Governing bodies. Since that date, however, its affairs have formed the subject of acrimonious discussion in the press, calculated to driving the intelligent public almost into a psychopathic state. Both are unfortunate. We are convinced that the only way of restoring peace and harmony so essential for orderly progress and of removing from the atmosphere of the Institute fear, suspicion, discontent, jealousy and all other unfortunate forms of emotional excesses, with which it is now charged, is to reorganise the entire constitution. We make no claim to being a prophet, but we must emphasize that the path of wisdom lies in the clear recognition of the spirit of the times and in the open-handed satisfaction of its reasonable demands.

We attribute the failure on the part of the Institute to fulfil the great intentions of its Founder, we trace the adverse remarks of the Reviewing Committees on the work of its departments and we assign all the later unfortunate developments in its premises, to the divided responsibility and the defective constitution under which the Institute has been labouring for the last quarter of a century. The Governing Council, consisting of exceptionally clever and good men, have been, in a spirit of absolute self-sacrifice, devoting a few hours in the year, snatched out of their pressing professional life, to the consideration of the affairs of the Institute, and it must not be surprising and unreasonable if their view-points and decisions should diverge from those of people who actually live these affairs all the laborious days of the year. We seem to forget that the ardent observations of the Reviewing Committees are as much applicable to the administration of the Governing Council, as they must be to the work of the staff. If the two spheres constitute a unitary concept of the life and activity of the Institute, it is not quite clear to our minds why the Reviewing Committees do not touch the Governing Council, and why they select only the members of the staff for the exercise of their tender solicitude. Is the Governing Council part or is it not a part of the Institute organisation? Is the Governing Council above the Committee's purview, because it is a composite body of elected and nominated members rendering voluntary service. To whom are the elected members responsible,—to their constituencies or to the Central Government? What is the constitutional, financial or academic relationship of these constituencies to the Institute? What interests do the elected members represent on the Governing Council? Do the Universities which now elect members to the Governing Council purport to prescribe the academic standards or to exercise vigilance over the research work of the Institute? Is there any political, social or academic institution whose affairs are entrusted to a Governing body, some of whose members represent definite interests and others, only general interests. Where the responsibilities of the group of members composing a single administrative unit belong to different constitutional orders, the fundamental principles of the organisation cannot be sound. We are of the opinion that this want of homogeneity in respect of the responsibilities of the members has been, for the past twenty-five years, operating as a conflicting and inhibiting factor, and that if the Institute is emancipated from this fatal anomaly it may start on a new life of hope and activity. The students and the staff are the only real and

legitimate custodians of the destiny of the Institute. It is their duty to fulfil the intentions of the Founder. They must enjoy the unfettered freedom to direct and influence the fate and fortune of the Institute. If, however, the concerned authorities do not see the need for altering the complexion of the constitution, they should have at least the fortitude of mind to face the probability of the next Reviewing Committee assessing the work of the Institute as falling within the programme of a glorified First Grade College.

We now proceed to indicate in broad outline the general changes which might profitably be introduced in the constitution for securing stability and stimulating cheerful co-operative effort in the Institute. We must, however, premise that the success of the experiment we propose depends on one very big condition, *viz., that the Professors should be as described by the Sewell Committee. In other words the Institute in the superior services should be peopled by scientific men of the eminence of Hopkins, Haber, Bergius, Robinson, Karrer, Hans Fischer, Debye, Armstrong, Morgan, Langmuir, Ruzicka, Kuhn, Aston, Bragg and Haworth.*

I. Management

The Visitor should be the final and absolute authority in all matters relating to the Institute.

The general management of the Institute should vest in the Institute Council, consisting of Professors, who should be its *ex-officio* members; one Reader, one Assistant Professor, one Lecturer and one student member, elected by their respective colleagues. The elected members should hold office for two years. The Rector of the Institute should be the Chairman, and the Registrar its Secretary.

The functions and duties now exercised by the Governing Council should be transferred to this new body.

The Institute Council should meet once a month and the minutes of the Proceedings should be furnished to the Government of India, the Tata Family, the Government of Mysore and such other Indian States and Provincial Governments contributing an annual subvention of Rs. 10,000.

II. Commission of Inspection

The administrative duties of the Institute Council and the academic work of the departments should be subject to annual review by a Commission of Inspection, appointed by the Central Government on the following basis:

1. Commissioner of Education—*Chairman.*
2. A representative of the Tata Family.
3. A representative of the Government of Mysore.
4. A representative of the Court.
5. A representative of the Inter-University Board.
6. A representative of the Federated Chambers of Industries and Commerce.
7. The President of the Court.
8. The Rector of the Institute should be the assessor to the Commission.

The inspection report should be submitted to the Government of India, the Tata Family, the Mysore Government, the President and members of the Court, to the members of the Institute Council, to the members of the Standing Committee and to all the Indian States and Provincial Governments making an annual subsidy of Rs. 10,000.

III. The Court

The Court should be reconstituted as follows: (1) Two nominees of the Visitor; (2) Two nominees from the Government of India; two from the Tata Family, two from the Mysore Government; (3) One nominee from each of the Indian States and Provincial Governments contributing Rs. 5,000 and more; (4) One nominee from each of the Industries and Commerce endowing a chair or paying an annual grant of Rs. 2,000; (5) One nominee from each of the Universities contributing Rs. 1,000 annually; (6) All the Professors of the Institute; (7) One elected Reader, Assistant Professor, Lecturer and Student; (8) Two members distinguished in Science and Industries or who have rendered meritorious public service, elected separately by (*i*) The Professors, (*ii*) The Readers, (*iii*) The Assistant Professors, (*iv*) The Lecturers and (*v*) The Students.

The Court should elect its own President. It should meet once in the year. Its functions and duties should remain as at present.

IV. The Standing Committee

The Court should constitute a Standing Committee from among its members which should assume the duties now discharged by the Finance Committee in addition to those assigned to it by the Court. The Standing Committee should consist of twelve members, three of whom representing the Central Government, the Tata Family and the Mysore Government should be *ex-officio*. The Rector of the Institute should act as assessor and the Registrar, as Secretary. The Standing Committee shall meet once in every quarter. The President of the Court shall be *ex-officio*, Chairman of the Standing Committee. The staff of the Institute shall not be eligible for election to the Standing Committee.

V. The Senate

The Senate should consist of Professors, Readers, Assistant Professors, two representatives of the junior members of the staff and two representatives of the students. The Rector should be the President and the Registrar its Secretary.

It should be competent for the Senate to re-examine the intentions of the Founder of the Institute in the light of interpretations put upon them by the Reviewing Committees. The re-orientation of the academic policy of the Institute should be included among the other functions and duties of the Senate. All decisions of the Senate should be subject to reconsideration by the Institute Council and confirmation by the Standing Committee. Proposals for inviting Visiting Professors and for exchange of Professors should fall within the purview of the Senate, subject to scrutiny by the Institute Council and final approval by the Standing Committee.

VI. Staff

The staff of the Institute should consist of Professors, Readers, Assistant Professors and Lecturers.

1. *Professors.*—The Professors should be distinguished alike for their character and for their scientific eminence whose achievements have been recognised by Learned Bodies like the Royal Society of London. Their salary and terms of appointment should be determined by the Standing Committee acting in conjunction with the Institute Council.

2. *Readers.*—Readers should be in charge of specialised subdivision of subjects forming corridors of the main departments. Readerships should be occupied by men of outstanding eminence.

3. *Assistant Professors and Lecturers* should be appointed on the basis of their approved capacity for research and for guiding students in the investigation of scientific problems in pure and applied branches.

4. The appointment of distinguished specialists as Visiting Professors and the institution of a definite scheme for exchange of Professors, Readers and Assistant Professors should form the settled and clear policy of the Institute.

5. The administrative head of the Institute should be designated Rector. He should be elected for the post by the Senate. The Rector shall hold office for a term of two years. Professors should be eligible for election.

6. The Rector should be assisted by a Bursar who should also be elected by the Senate for a term of two years from among the Professors and Readers, whose duties will be to look after the finances of the Institute, and to act for the Rector during his absence from the Institute. The Rector should establish sympathetic contacts with industries, commercial organisations, Indian States and Provincial Governments and Universities and official Research Centres and Scientific Surveys for co-ordination of work and for enlisting financial support. The Rector and Bursar should be eligible for re-election.

VII. Selection of Staff

The Selection Committees should be constituted by the Institute Council subject to the approval of the Visitor. The panel of names (the Selection Committees need not necessarily confine the choice to applicants, but should enjoy the power of inviting those who may feel delicate to apply), submitted by the British and Indian Committees should be first scrutinised by the Institute Council at a special meeting

called for the purpose. A further choice should be made by the Institute Council, which together with the original recommendations should be forwarded to the Standing Committee, with such observations as the Institute Council might desire to offer. The Standing Committee should make the final nomination for the approval of the Visitor, at a special meeting convened for the purpose, and the nomination should be accompanied by a report prepared by the Chairman. It should be competent for the Institute Council to prescribe the terms of advertisement, and all the subsidiary matters relating thereto, including the date for summoning the meeting of the Standing Committee in order to avoid undue delay. The appointment of Readers should follow the same procedure. The nominations of the Standing Committee should be subject to approval of the Visitor.

The procedure for the appointment of Assistant Professors should be similar to that followed in the case of Professors, except that the authority of selection should vest in the Council and the Standing Committee being invited to approve the action of the Council. The Institute Council should have the authority to appoint Lecturers either after advertising the posts or by direct recruitment from among the senior students.

VIII. Students

The Senate should prescribe the qualifying test for admission of students to the different departments. Their number in each department should be prescribed. Universities contributing Rs. 1,000 should have the power to select their own students. Provincial Governments and Indian States and Industries making a grant of Rs. 5,000 and more should also enjoy the privilege of nominating their students. Where, however, such nominating bodies are non-existent, the Senate should make the selection with due consideration to the interests of the Provinces.

Students should be allowed to form a Union or a Federation of their own whose main object should be the promotion of their physical and intellectual welfare. The management of hostels and sports sections should be delegated to them. They should be associated with the work of the Senate, the Court and the Council, giving them opportunities for representing their views in the field of administration of the Institute.

We are aware that the suggestions we have ventured to indicate above will offend the conservative temperament of administrators who will either smile or scoff or may even brush them aside as impractical. But few realise that the acid test of a good administration of a scientific Institution such as the Indian Institute of Science is our attitude to the students, not merely because that these young men hold in their hands the key to all future developments of the country, but because from a closer co-operation with them we can gather valuable information of our own unconscious mind. If we treat our students with greater humanity and more respect, and if we succeed in eliminating their vast charges of fear and distrust, we might hope to produce a generation better equipped for solving the problems of this complicated world.

We have offered our remarks in good faith and in a spirit of helpfulness. In our judgment the Central Government, the Tata Family, and the Mysore Government, which have the greatest stake in the well-being and prosperity of the Institute, apart from safeguarding their interest, would render distinct public service, if they jointly move for the appointment of a committee,

(1) to investigate the psychological background of the existing state of affairs,

(2) to study all the documents relating to the Foundation, including the reports of the Committee, and

(3) to examine the proceedings of the Council which either accelerated or retarded the fulfilment of the intentions of the Founder and the recommendations of the Committees.

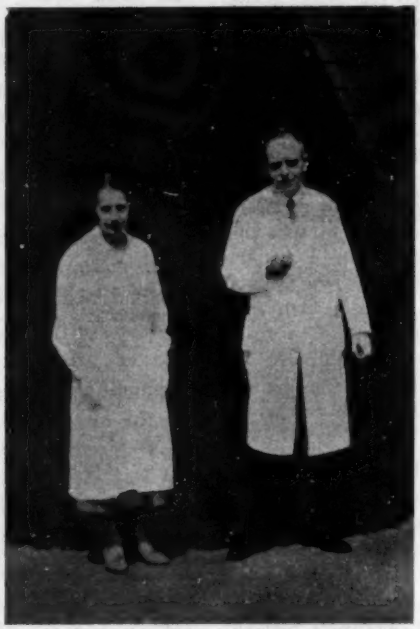
We have no doubt that when such a Committee of Investigation draw up their report, the main features of their findings will not materially differ from what we attempted to depict.

Otto Hahn zum sechzigsten Geburtstag (8. März 1939)

AM 8. März dieses Jahres haben Chemiker und Physiker aus allen Teilen der Welt Otto Hahn zu seinem sechzigsten Geburtstag ihre Glückwunsche zum Ausdruck gebracht, in Verehrung für seine grossen wissenschaftlichen Leistungen, in Liebe und Dankbarkeit für das, was er als Mensch und Lehrer so vielen gegeben hat.

Ich bin aufrichtig dankbar, daß auch mir die Gelegenheit gegeben wird, dem Manne, mit dem mich eine mehr als dreissigjährige gemeinsame Arbeit und eine ebensolange herzliche Freundschaft und innerste Verbundenheit verknüpft, einen wenn auch verspateten Geburtstagsgruss darzubringen.

Otto Hahn's menschliche und wissenschaftliche Persönlichkeit sind eine untrennbare Einheit. Eine sehr lebendige geistige Intuition, ein sehr gediegenes Können, ein ausgezeichnetes und kritisches Beobachtungsvermögen, eine unbeirrbare Zuverlässigkeit und Beharrlichkeit neben grosser innerer Bescheidenheit und natürlicher Liebenswürdigkeit kennzeichnen den Menschen wie das Werk.



Frau Professor Lise Meitner. Professor Otto Hahn
(*Vor Dem Kaiser Wilhelm Institut für Chemie*)

Schon der Anfang seiner wissenschaftlichen Laufbahn ist charakteristisch fur ihn. Als organischer Chemiker geht er im Jahre 1904—nach zweijähriger Assistententätigkeit sufällig in das Gebiet der Radioactivität bei Zincke in Marburg—nach England in das Laboratorium von Ramsay, wo er ganz aufällig in das Gebiet der Radioactivität gerät. Und bereits nach halbjähriger Arbeitszeit entdeckt er eine neue radioactive Substanz, das Radiothorium. Diese Tatsache bestimmt Hahns weiteren Lebensweg. Um das Gebiet von Grund auf kennen zu lernen, geht er 1905 zu Rutherford nach Montreal, und dieses Ausbildungsjahr an der McGill University führt ihn schon zu einer Reihe schöner wissenschaftlicher Erfolge. Neben mehreren zum Teil mit Rutherford ausgeführten Arbeiten über Reichweite und Ladung der Alphastrahlen entdeckt er in einer ganz selbständigen Untersuchung das Radioactinium.

Im Jahre 1906 kehrt er nach Deutschland zurück und beginnt seine selbständige wissenschaftliche Laufbahn im Emil Fischerschen Institut in einem kleinen, ursprünglich als Holzwerkstatt vorgesehenen Raum. Aus dieser "Holzwerkstatt" sind eine Reihe seiner schönsten Arbeiten in die Welt gegangen. Hier hat er die Substanzen Mesothorium 1 und Mesothorium 2 entdeckt, hat unabhängig von etwa gleichzeitigen Arbeiten von Boltwood beziehungsweise Marckwald das Ionium als Muttersubstanz des Radiums nachgewiesen, hat den mit der Emission der Alphastrahlen verbundenen Rückstoss entdeckt und vieles mehr.

Ende 1907 begann unsere gemeinsame Arbeitstätigkeit, die — neben zeitweiligen durch die Gebietsentwicklung bedingten getrennten Arbeitsrichtungen — sich über ein halbes Menschen leben erstrecken sollte. In diesen Jahren wurden als neue radioactive Substanzen die Körper Thorium C″, Radium C″ und Actinium C″ gefunden, eine Reihe von Untersuchungen über Betastrahlen—zum grossen Teil in Gemeinschaft mit O. v. Bayer—gemacht, die zur Auffindung der (sekundären) Betastrahlspektren führten, und es wurde das Protactinium entdeckt. Im Jahre 1912 wurden die Arbeiten aus der "Holzwerkstatt" in eine kleine radioactive Abteilung des Kaiser Wilhelm Instituts für Chemie verlegt, aus der sich im Laufe der Zeit ein weitgehend für radioactive Forschungen eingerichtetes Institut entwickelt hat mit einer dem Gebiet entsprechenden

Zweiteilung für chemisch-radioactive und physikalisch-radioactive Arbeiten. Seit 1929 ist Otto Hahn Direktor des Kaiser Wilhelm Instituts für Chemie.

In den Jahren nach dem Weltkrieg hat Hahn unter Anderem das Uran Z entdeckt, das, wie wir heute wissen, das erste Beispiel einer Kernisomerie darstellt. Und mit einer grossen Zahl von Schülern und Mitarbeitern hat er das Gebiet der angewandten Radiochemie um sehr grundlegende Ergebnisse bereichert, deren volle Bedeutung bei der heute zur Verfügung stehenden Zahl von künstlichen radioactiven Atomarten noch gar nicht zu übersehen ist. Hahn selbst hat in einem aus Vorträgen in Amerika hervorgegangenen Buch "Applied Radiochemistry" die Hauptergebnisse dieses Gebiets zusammengestellt. Und der Einleitungsvortrag "From the ponderable to the imponderable" ist ein besonders schönes Beispiel für Hahns weitumfassende Beobachtungsfreude und Beobachtungsgabe und für seine liebenswürdige menschliche Art.

Im Jahre 1935 haben wir wieder eine Zusammenarbeit begonnen, um die bei Neutronenbestrahlung von Uran und Thorium hervorgerufenen künstlichen Umwandlungsprocesse zu untersuchen, woran im weiteren Verlaufe F. Strassmann mitbeteiligt war. Diese Arbeiten hatten zur Auffindung mehrerer Umwandlungsreihen gefuhrt, wobei ein Teil der Umwandlungsproducte als Transurane charakterisiert wurden.

In den letzten Monaten haben Hahn und Strassmann bei dem weiteren Studium dieser Umwandlungsprocesse ganz neue und sehr weittragende Resultate erhalten. Sie konnten ziegen, dass sowohl der Urankern als der Thoriumkern durch das Einfangen des Neutrons nicht — wie ursprünglich angenommen — in Radium—beziehungsweise Actiniumisotope übergehen, sondern in niedrigere Kerne zerreissen. Das vermeintliche Radium ist Barium, das Actinium ist Lanthan und so weiter, und daneben entstehen als zugehörige Spaltstücke Krypton, Rubidium, Strontium und so weiter.

Hahn hat sich mit diesen wunderbaren Ergebnissen selbst das schönste Geschenk zu seinem sechzigsten Geburtstag beschert.

Mögen sich für ihn, wie bisher, so auch in Zukunft, im schönsten Sinn der Worte "Verdienst und Glück verketten".

LISE MEITNER.

Dr. A. M. Heron, D.Sc. (Edin.), F.G.S., F.R.G.S., F.R.A.S.B., F.N.I.

DR. A. M. HERON, Director, Geological Survey of India, retired on the 24th of March after a long and distinguished career. Dr. Heron joined the Department in 1906 after attaining high academic distinctions at the Edinburgh University and earlier at the Royal High School, becoming in 1935, the head of the Geological Survey of India.

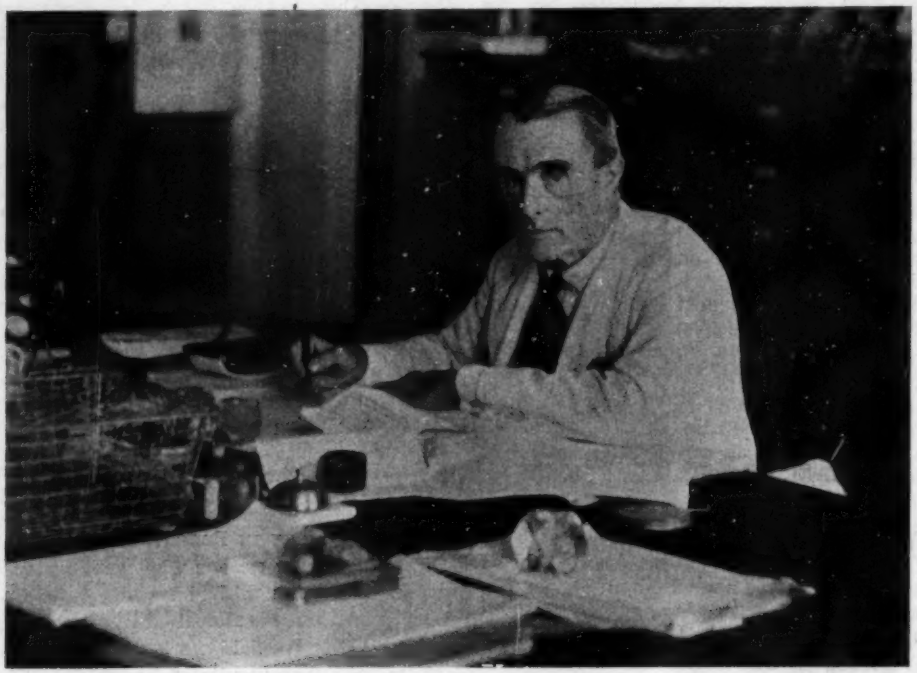
Dr. Heron has been versatile in his activities and interests and was President of the Mining, Geological and Metallurgical Institute of India, President of the Geography Section of the Indian Science Congress, Vice-President of the Royal Asiatic Society of Bengal and of the National Institute, a Fellow of the Royal Geographical Society and of the Royal Society of Edinburgh. In addition to his scientific activities, he is a keen sportsman and was President of the Calcutta Rowing Club and of the Himalayan Club.

WORK IN RAJPUTANA

There has been no one who possesses such a long and distinguished record—extending over a period of almost thirty years—of continuous active field-work to his credit as Dr. Heron. The results of his field-surveys are embodied in numerous publications dealing with every aspect of the Geology of Rajputana, on which he is a noted authority. From the very inception of his geological career in India he has worked on the Archæan and other pre-Cambrian formations almost without a break. He is in fact one of the most versatile exponents of the geology of the ancient rocks of India. His association with the pre-fossiliferous rocks has indeed been so close that for the first twenty-five years of his career, Dr. Heron never saw a fossil—in the field!

The First Everest Expedition

Dr. Heron acted as Geologist to the first Mount Everest Expedition in 1921, the scientific results of which are embodied in his *Geology of the Himalaya Mountains and Tibet* and *Geological Results of the Mount Everest Reconnaissance Expedition*. It is unnecessary to enumerate here the many memoirs published by him on geological, economic and other aspects of Indian Geology.



Dr. A. M. Heron

Tavoy and Mergui

Not the least important of his contributions is the work he carried out during the Great War in the Tavoy and Mergui districts of Burma for the supply of tungsten. This work received the appreciation of the Government which it deserved.

Dr. Heron is a man of great energy which evinces itself in his insatiable desire for active field-work. It is good news that his long and varied experience will still be available, as he proposes to stay in India for some months for advisory work.

Not the least of Dr. Heron's qualities is that unique and rare sense of humour, so uncommon among scientists. Dr. Heron's retirement is greatly regretted by his colleagues and wide circle of friends, every one of whom had the highest regard for his friendship and genial personality. We wish him good luck in the enjoyment of many years of sound health, and the pursuit of scientific activities. Knowing his dynamic personality, it is impossible to believe that he would really enjoy what is conventionally known as "hard-earned rest".

LETTERS TO THE EDITOR

A Note on Self-Reciprocal Functions

I will say that a function is $\pm R_\nu$, according as it is self-reciprocal or skew-reciprocal for Hankel Transforms of order ν; that is, according as it satisfies the integral equation

$$f(x) = \pm \int_0^\infty \sqrt{xy}\, J_\nu(xy)\, f(y)\, dy, \quad (\nu > -1)$$

with the upper or the lower sign.

In a recent paper[1] I have proved the theorem: If $f(x)$ is R_ν, the function

$$\phi(x) = a^\alpha f(x^\alpha) \pm \frac{1}{a^\alpha} f\left(\frac{x}{a^\alpha}\right),$$

where $a > 0$, $\alpha > 0$, is $\pm R_\nu$.

The object of this note is to give an easy generalisation of this theorem.

2. *Theorem I.*—If $f(x)$ is R_ν, the function

$$\phi(x) = F(a)\, f\{xF^2(a)\} \pm \frac{1}{F(a)} f\left\{\frac{x}{F^2(a)}\right\}, \tag{2·1}$$

where a is a constant, and $F(a) \neq 0$, is R_ν.

We have

$$\int_0^\infty \sqrt{xt}\, J_\nu(xt)\, \phi(t)\, dt$$

$$= \int_0^\infty \sqrt{xt}\, J_\nu(xt) \left[F(a)\, f\{tF^2(a)\} \pm \frac{1}{F(a)} f\left\{\frac{t}{F^2(a)}\right\} \right] dt$$

$$= F(a) \int_0^\infty \sqrt{xt}\, J_\nu(xt)\, f\{t\, F_2(a)\}\, dt$$

$$\pm \frac{1}{F(a)} \int_0^\infty \sqrt{xt}\, J_\nu(at)\, f\left\{\frac{t}{F^2(a)}\right\} dt$$

$$= \frac{1}{F(a)} \int_0^\infty \sqrt{\frac{xu}{F^2(a)}}\, J_\nu\left\{\frac{xu}{F^2(a)}\right\} f(u)\, du$$

$$\pm F(a) \int_0^\infty \sqrt{xu\, F^2(a)}\, J_\nu\{xuF^2(a)\}\, f(u)\, du$$

$$= \frac{1}{F(a)} f\left\{\frac{x}{F^2(a)}\right\} \pm F(a)\, f\{xF^2(a)\}$$

$$= \pm \phi(x).$$

Theorem II.—If $f(x)$ is $-R_\nu$, the function (2·1) is $\mp R_\nu$.

Brij Mohan.

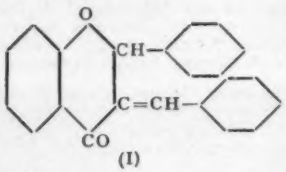
Benares Hindu University,
India,
March 18, 1939.

[1] "A few Self-Reciprocal Functions," *Proc. Physico-Math. Society of Japan*, 1934, 273–74.

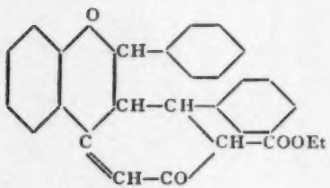
Benzylidene-Flavanones considered as Chalkones

Panse and Wheeler[1] have shown that Benzylidene-Coumaranones like chalkones condense with acetoacetic ester, desoxybenzoin, cyclohexanone, etc. It is now found that

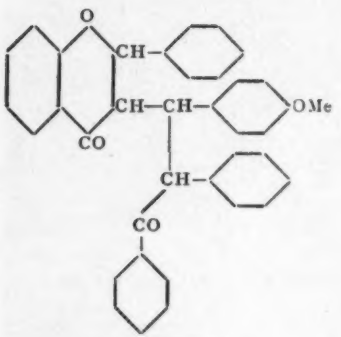
Benzylidene-Flavanones of the type (I) which contain the group -CO-C:CH- present in chalkones also undergo the above types of reactions, (II) and (III) being obtained by the condensation of the corresponding benzylideneflavanones with acetoacetic ester and desoxybenzoin respectively. The oxides (IV) and (V) analogous to chalkone oxides have also been prepared. Similar compounds have been obtained from other arylideneflavanones.



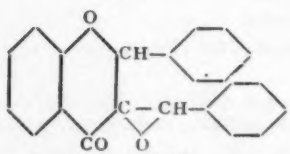
(I)



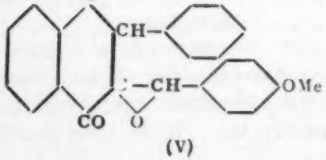
(II)



III)



(IV)



(V)

R. N. KULKARNI.
R. C. SHAH.
T. S. WHEELER.

Royal Institute of Science,
Bombay,
May 4, 1939.

[1] *Curr. Sci.*, 1938, **7**, 181.

A New Synthesis of 3-Aminocoumarin

ERLENMEYER, JUN. AND BADE[1] state that salicylaldehyde does not condense with glycine to give α-amino-β-hydroxy acids by the method associated with the name of Erlenmeyer. Linch[2] has published a paper on 3-aminocoumarin; he found that salicylaldehyde and glycine did combine, in the presence of sodium acetate and acetic anhydride by Perkin's method, to give 3-acetyl-aminocoumarin, which on hydrolysis gave 3-aminocoumarin, but that the yield of the former was very unsatisfactory, being 25–30 per cent. at best. He has therefore followed a roundabout method of condensing salicylaldehyde with ethylacetoacetate (Knoevenagel) to obtain 3-acetylcoumarin, the oxime of which on undergoing the Beckman transformation, gave 3-acetylaminocoumarin and this on careful hydrolysis gave the base. The exact yield calculated on the first starting materials is not stated, but the method is said to be advantageous.[3]

We now find that salicylaldehyde and glycine, when heated directly together at 130–140° for five hours, give the 3-aminocoumarin in about 23 per cent. yield, and that yield can be further augmented by the use of a trace of pyridine. The ultimate yields obtained by suitable modifications, are exceedingly good. In two experiments the yields were 80 per cent. and the condensation of salicylaldehyde and glycine proceeded very well. Salicylaldehyde (1·5 mol.), glycine (1 mol.) and a trace of pyridine were heated together for five hours at 130–140°. The product crystallised from water melted at

130° and was identical with the 3-aminocoumarin obtained by the method of Linch.

Yield 80 per cent. of theory.

Other aldehydes are being investigated.

K. C. PANDYA.
TEJPAL SINGH SODHI.

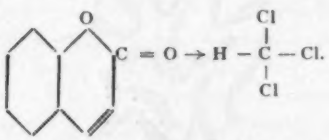
Department of Chemistry,
St. John's College,
Agra,
March 28, 1939.

[1] *Annal.*, 1904, **337**, 222–35; *C.A.*, 1905, **1**, 131.
[2] Linch, *J.C.S.*, 1912, T., 1758.
[3] Linch, *loc. cit.*

Molecular Complexes in Chloroform Solution

THAT polar solvents are capable of forming complexes with suitable solutes has been fairly well recognised and various methods have been used for detecting their formation.[1] Chloroform is said to undergo these combinations through a co-ordinate bond involving its H atom.[2]

It was recently shown by us[3] that the Raman line for the C = O group of coumarin in chloroform solution undergoes a marked shift towards the exciting line as compared with a carbon tetrachloride solution which was taken as the standard. The phenomenon was explained as due to the formation of hydrogen bond as below:—



As a result of this complex formation, in which the oxygen atom of the C = O is the donor and the hydrogen of chloroform the acceptor, the C = O bond is diminished in strength and the frequency is reduced. In the course of the extension of this work a large number of carbonyl compounds have been studied in carbontetrachloride and chloroform solutions. In the case of saturated ketones, acids or esters no difference between the two solvents was noticed. Obviously with these substances complex formation, if it took place at all, could not produce sufficient change to be exhibited in the Raman spectra. On the other hand, in unsaturated carbonyl compounds such as those given in the table below there was appreciable effect which could be noticed by a definite broadening of the line and a shift towards lower frequencies.

TABLE I

The C = O frequencies are given in $\Delta\tilde{\nu}$

Substance	Pure state	Chloroform solutions	Carbon tetrachloride solutions
Benzylidine acetone	1668	1653	1670
Methyl cinnamate	1712	Diffuseness towards shorter wave-lengths	1712
Ethyl cinnamate ..	1712	Do.	..
Phenyl cinnamate	1740	1722	1740
Coumarin ..	1708, 1731	1720	1742

Further work in regard to the detailed study of these is in progress. The close resemblance between coumarin and phenyl cinnamate in this respect is noteworthy and finds an easy explanation in the similarity of their structures.

G. V. L. NARASIMHA MURTI.
T. R. SESHADRI.

Department of Chemistry,
Andhra University, Waltair,
April 26, 1939.

[1] Macleod, *Trans. Farad. Soc.*, 1934, **30**, 482; Macleod and Wilson, *ibid.*, 1935, **31**, 596; Glasstone, *ibid.*, 1936, **31**, 200; Bramley, *J.C.S.*, 1916, **109**, 11–14 and 343–519; Smith and Berkmans, *Proc. Roy. Acad. Sci.*, Amsterdam, 1918, **401**, 21; Dolezalek, *Z. Physik. Chem.*, 1910, **71**, 191.
[2] Walter Gordy, *Nature*, 1938, **142**, 831.
[3] Murti and Seshadri, *Proc. Ind. Acad. Sci.*, 1938, **8**, 519.

Vitamin C in Pulmonary Tuberculosis

PHYSIOLOGICAL properties of Vitamin C such, among others, as its action on vascular permeability, its role in intoxication and in tissue respiration and its action on formative cells, suggest its application in Pulmonary Tuberculosis therapy. Some useful work has already been done in this field. A comprehensive study on the relation between Vitamin C and pulmonary tuberculosis is being carried on in this Department by Dr. S. K. Roy and the results already obtained are encouraging.

A study of the urinary excretion of Vitamin C by the method of Harris and Ray[1] as later modified,[2] proved that the system is highly unsaturated with Vitamin C in pulmonary tuberculosis cases. Fig. 1 gives a picture of

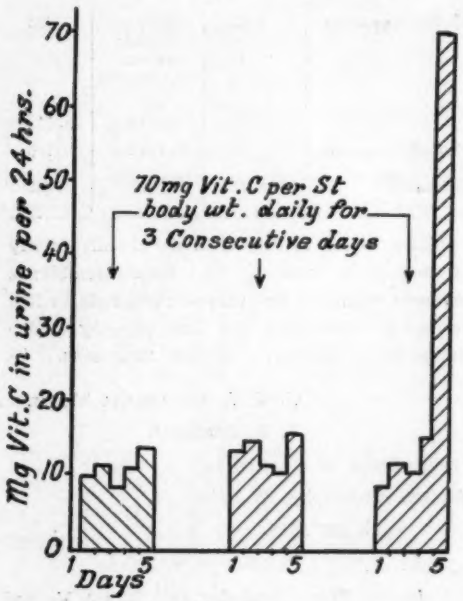


FIG. 1

this state of unsaturation. Administration of 70 mg. of Vitamin C per kg. of body weight for three consecutive days failed to saturate the body in most cases of pulmonary tuberculosis. In hæmoptysis, Vitamin C excretion falls rapidly and rises with the stoppage of hæmoptysis.

Administration of 350 mg. of Vitamin C daily to pulmonary tuberculosis patients, makes a decided improvement in the general blood picture, sedimentation rate, von Bonsdorff's count and Houghton's index.

The investigation is being continued.

M. N. RUDRA.

Department of Medical Chemistry,
Prince of Wales Medical College,
Patna,
March 18, 1939.

[1] *Lancet*, 1935, 1, 71.
[2] *Ibid.*, 1935, 2, 1399.

Supernumerary Chromosomes in Para-Sorghum

A CYTOLOGICAL examination of a number of plants of *Sorghum purpuero-sericeum* Ashers et Schwenf, grown at the Imperial Sugarcane Breeding Station, Coimbatore, from seeds received from Kew as originally collected from the Sudan, showed that the chromosome number in this species of Sorghum varies from $2n = 10$ to $2n = 14$. The haploid set of 5 which was also found in the two other para-Sorghums examined, *S. versicolor* Anderss and *S. dimidiatum* Stapf. could be easily identified in plants of *S. purpuero-sericeum* with 10 chromosomes, by their different lengths and the nature of their attachment constrictions (Fig. 1). A pair

FIG. 1

Mitotic metaphase in *S. purpuero-ecriceum*
$2n = 10$ × 2700

of nucleolar chromosomes possessing the characteristic satellite could be easily distinguished. The extra chromosomes in plants having more than 10 chromosomes are found to be identical with the smallest or fifth chromosome in length

and in having a sub-median attachment constriction (Fig. 2). At meiosis these extra

FIG. 2

Mitotic metaphase in *S. purpuero-sericeum*
$2n = 10 + 2$ × 2700

chromosomes may be seen as univalents or they may pair amongst themselves or with the fifth chromosome to form bivalents, trivalents or tetravalents.

The plants in which these extra chromosomes occur are found to be in no way different from those in which they are absent. It is highly probable that these supernumerary chromosomes like those first observed in Maize (Longley, 1927) and in Paspalum (Avdulov and Titova, 1933) are impoverished of genes. They, however, differ from the "B" chromosomes of maize in having a well-defined attachment constriction and in being homologous with one of the chromosomes of the normal haploid set.

Ten has been commonly reported as the basic number in the Andropogoneæ and the discovery of the five-chromosome species *S. versicolor* (Karper, 1930), has been considered as a direct evidence for this. However, multivalent associations are found in nearly all diploid species of Sorghum, and associations higher than quadrivalents reported in the tetraploid *S. halepense* by Huskins and Smith (1934). These workers have not found fewer than 7 units of association in the Sorghum material examined by them. This, and the frequency with which the chromosome number 7 and its multiples occur in Graminæ, raise the possibilities of this number rather than 5 being the basic number in Sorghum. The discovery of types amongst *S. purpuero-sericeum* with chromosomes ranging from $2n = 10$ to $2n = 14$ seems to indicate that this species of Sorghum probably represents one of the stages in the process whereby chromosomes are gradually eliminated in the evolutionary fall in the basic chromosome number from 7 to 5.

E. K. JANAKI AMMAL.

Imperial Sugarcane Station,
Coimbatore,
May 1, 1939.

Avdulov, N., and Titova, N., "Additional Chromosomes in *Paspalum stoloniferum* Bosco," *Bull. Appl. Bot.*, Leningrad, 1933, Ser. 2 (2), 165–72.

Huskins, C. L., and Smith, S. G., "A Cytological Study of the Genus Sorghum," *Jour. Gen.*, 1934, **28**.

Longley, A. E., "Supernumerary Chromosomes in *Zea Mays*," *Jour. Agri. Res.*, 1927, **35**, 769–84.

Karper, R. E., "Inheritance in Grain Sorghums," *Texas. Agri. Exp. Sta. Records*, 43rd Ann. Report, 1930.

How Mid-Rib Hardness affords Resistance to the Sugarcane Top-borer *Scirpophaga nivella* F., in India

THE sugarcane top-borer, *Scirpophaga nivella* F., is found almost all over India where at present about 4,500,000 acres are under sugarcane owing to the recent rapid development of the sugar industry.

In some of the sugarcane tracts about 70% of the sugarcanes at harvest time are found attacked by the top-borer. Attacked canes exhibit a drying shoot and become stunted and often have a bunchy top owing to the upper side buds developing into branches. Besides this damage, the attack by this pest kills off many young shoots and prevents the growth of many shoots into millable canes. At harvest time millable canes bored by this pest show an average loss of 20% in weight. During some years the loss is much more.

It has been found as a result of field observations carried out during 1937 and 1938 that some varieties of sugarcanes are definitely more resistant to this pest than others. All these resistant varieties have in common very strong hard mid-ribs in their leaves. The varieties that are badly attacked have rather weak mid-ribs often with drooping leaves.

Examination of the habits of the pest in the field during the last two years showed that the newly hatched larva gets into the shoot by first biting into a mid-rib a few inches above the base of an upper almost fully unfurled leaf and then tunnelling down the mid-rib to the base where the leaf is in contact with the shoot. From here it tunnels into the centre of the shoot. If a larva cannot get into the one particular leaf out of the whole bunch of leaves it perishes and what is more important is that if this particular leaf has a strong mid-rib, it is unable to pass into the mid-rib within a certain period from the time of hatching and it perishes for want of food and shelter. Usually when a plant has been attacked by one larva no other larva tries to get into the same plant.

Experimental cultivation on a replicated basis of different varieties of sugarcane during 1937 and 1938 has given statistically significant differences in favour of the strong mid-ribbed varieties regarding their resistance, during the whole period of their growth, to attack by *Scirpophaga nivella* F. General observations in sugarcane tracts also support the view that fewer *Scirpophaga nivella* F., are found attacking varieties of sugarcane with strong mid-ribs. Some varieties with weak mid-ribs have been found to be very badly attacked and reduced to bunchy, leafy, grassy clumps. In Bihar early in 1939 in a sugarcane field about to be harvested, it was found that the extent of *Scirpophaga nivella* F., attack in millable canes was 17% in the variety Co. 513 which has a strong mid-rib whereas the attack was 71% in the variety Co. 210 which has a weaker mid-rib.

The botanical factors that go with the strong mid-rib in the resistant sugarcanes are under study. Efforts are being made to popularise varieties of sugarcanes which combine in them the best economic factors together with that of the very strong mid-rib.

P. V. Isaac.

Imperial Agricultural Research Institute,
New Delhi,
April 21, 1939.

Origin of the Inferior Ovary in the Amaryllidaceæ

There are at present two main views about the origin of the epigynous flowers among the angiosperms. According to the first view, the inferior ovary is of receptacular origin and epigynous flowers are the result of a cup-like development of the floral receptacle which has fused with the original ovary wall and carried the other floral organs at its distal end. According to the second view, the epigynous flowers are the result of fusion of the ovary, and basal portions of stamens, petals and sepals. The wall of the ovary, therefore, consists morphologically, not of the receptacles, but of the basal portions of all parts of the flower.

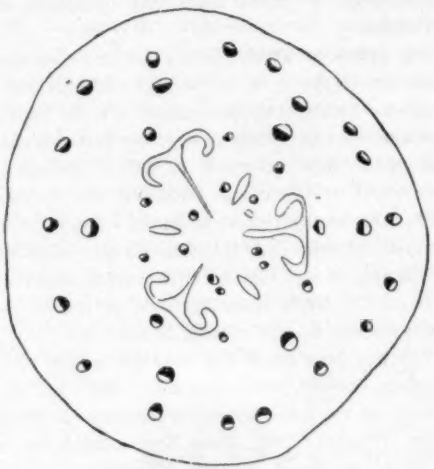


Fig. 1

Polyanthes tuberosa

Transverse section of the inferior ovary about its middle showing the arrangement of vascular bundles

In order to determine the exact morphology of the inferior ovary in the Amaryllidaceæ, we have carried out an anatomical investigation of the flower of *Polianthes tuberosa* Linn., and find that this supports the second view.

The traces for the various floral parts separate out from the stele of the receptacle below the ovary, and in the wall of the inferior ovary the bundles of the sepals, petals and stamens and

carpels are present quite distinct from one another. This is quite clear from the accompanying figure which represents a transverse section of the ovary about its middle. There are seen on the outside 18 bundles for the six perianth leaves, each perianth leaf being supplied by three (one midrib bundle and two lateral bundles). Next there are six stamen bundles, one for each stamen, just to the inside of the six midrib bundles of the perianth leaves. Finally we see in the middle of the transverse section, the vascular supply of the three carpels, consisting in each case of a dorsal bundle, two dorso-lateral bundles at the sides of the carpels, two ventral bundles and their lateral branches. It is thus quite clear that in this case the inferior ovary is the result of fusion of the basal portions of six perianth leaves, six stamens and ovaries of three carpels.

A. C. Joshi.
J. V. Pantulu.

Department of Botany,
Benares Hindu University,
March 29, 1939.

The Occurrence and Inheritance of Purple Blotched Grains in Sorghum

The sorghum grain may be white or coloured, and may be pearly or chalky. When coloured, the colour may be yellow, red or brown. The depth of yellow and red may vary; so also that of brown, which could be independent or be superimposed on yellow or red. These variations will appear differently on pearly and chalky backgrounds. The many possible combinations of these factors result in the wealth of colours in the sorghum grain. The above colours are whole and are manifested over the whole of the pericarp. There are a few deviations from this whole colour manifestation. One such deviation in which the grain tips are purple coloured has been recorded[1]; here the purple tip is definitely round the stylar base.

In this note the occurrence and inheritance of purple blotched grains are recorded. Some of the varieties received from America, which are African in origin, are described as having flecked, red or black splashed grain. Possibly, these belong to the group of blotched grains.

The blotching is due to patches of purple coloured areas randomly distributed over the seed coat (see illustration). The colour of

Blotched Not Blotch d
Sorghum grains

Fig. 1

blotching may be reddish purple or blackish purple according as the root, leaf-sheath, and glume parts are coloured reddish purple or blackish purple. Blotching shows best against a white background. It could manifest on a background of other pericarp colours. Blotching is confined mostly to the pericarp layer. The colour is concentrated in the cuticle and epicarp, and gets lighter in the hypoderm and mesocarp, and in the cross and tube cells below. When blotching is heavy, it disintegrates all these layers and penetrates into the endosperm which it discolours slightly. In extreme cases there may be little pockets of air and this is revealed by tiny bubbles coming out when blotched grains are soaked. The blotches vary in size from a pin head to 2 mm. in diameter. Small blotches run into each other. They have no regularity in shape. They occur mostly in the exposed portions of the grains and could also occur at the base of the grain clipped up by the glumes and not exposed to light.

Blotching appears late in the development of the seed and is not noticed before the milky stage. Small blotches form in the dough stage of the grain and spread as the seeds mature.

Blotched grains are essentially African in origin. They are met with mostly among the Kafirs (*Sorghum caffrorum*, Beauv.), Feteritas (*S. caudatum*, Stapf.) and Nigricans [*S. nigricans* (Ruiz et Pavon) Snowden]. The Indian sorghums are free from blotching, though there are odd types of *Sorghum cernuum* evidencing a taint of blotching. Blotched grains tend to occur mostly in varieties with a blackish purple leaf-sheath and with grains having opaque and chalky colour.

In a cross between blotched and non-blotched grain types, the F_1 was blotched and the F_2 gave a simple monogenic ratio. In family A.S. 5379 which segregated for blotching there were 105 plants with blotched grains and 31 without blotching, showing that the blotched condition was a simple dominant to the common unblotched condition.

In crosses between a Kafir with blotched and purple tipped grain and a Milo with neither blotching nor purple tip, the F_1 had both blotching and purple tip. In the F_2 there was segregation for both the characters. Family A.S. 5382 gave a ratio of 64 purple tipped and blotched, 21 blotched alone, 20 purple tipped alone, and 7 with neither purple tip nor blotching. This segregation shows that the factor for purple blotching is independent of the factor P_{GT} which produces a purple tipped grain.

A factor designated PB produces purple blotches on the sorghum grain. PB is a simple dominant to pb. The factor pair PB — pb is independent in inheritance of the factor pair P_{GT} — p_{gt}, determining the presence or absence of a purple tip on the sorghum grain.

G. N. Rangaswami Ayyangar.
V. Panduranga Rao.
A. Kunhi Koran Nambiar.

Millets Breeding Station,
Coimbatore, S. India,
April 8, 1939.

[1] Rangaswami Ayyangar, *et al.*, *Proc. Ind. Acad. Sci.*, (B), 1938, **8**, 396–98.

Genic Differences Governing the Distribution of Stigmatic Feathers in Sorghum

The physical attributes of the style and stigma in sorghum, their length, and the length and distribution of stigmatic feathers have been given in a previous article.[1] The homology of style and stigma to the subule and column of the awn has been proved in a subsequent article.[2] Further data[3] on this homology were furnished, and the simple dominance of an equal stylar and stigmatic distribution to a longer style and a shorter stigmatic area has been recorded. In two subsequent articles[4,5] a localisation of the feathers and the extension of the feather to the stylar arms, with corresponding repurcussions on the awn was described and the inheritance of basal feathers given. In this note we are recording the fact that the distribution of the feathers on the stigma may be bushy or sparse with a genetic background.

The stigmatic feathers are very bushy in all cultivated varieties and also in the wild types. This is the normal condition. Among the African varieties of sorghum received through the courtesy of Kew, and grown at the Millets Breeding Station, three races of *Sorghum coriaceum* Snowden and one of *S. conspicuum* Snowden have sparse stigmatic hairs. To the naked eye this was easy to detect at the time of anthesis. The feathers in the sparse type were about 25 to 30 per one millimetre length of stigma as against 150 to 200 of the normal stigma. The individual feathers in the sparse type were slightly longer than those of the bushy type and the stylar arms were also a bit thicker.

A.S. 4378—a sparse feathered *Sorghum coriaceum* was crossed with A.S. 60—a bushy feathered *Sorghum durra*. The F_1 was like the bushy parent. In the F_2 the following segregations were obtained:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 4757	100	35
,, 4758	65	21
TOTAL ..	165	56
Calculated 3 : 1 ..	166	55

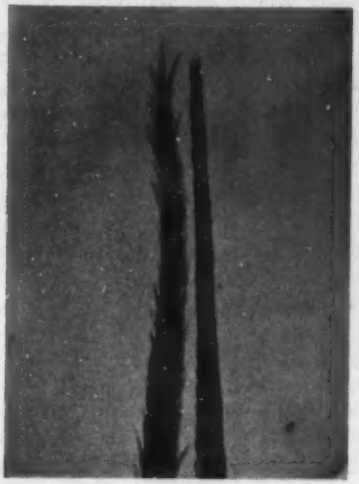
In the F_3, of the 13 bushy feathered selections taken from A.S. 4757, three turned pure and ten segregated as follows:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 5499	66	23
,, 5500	140	48
,, 5501	102	41
,, 5504	112	38
,, 5505	110	49
,, 5507	96	33
,, 5508	153	45
,, 5509	130	30
,, 5511	112	36
,, 5512	132	46
TOTAL ..	1153	389
Calculated 3 : 1 ..	1156·5	385·5

In the F_4 (from A.S. 5512) of 5 bushy selections, one was pure and four segregated as under:—

Family No.	Stigmatic feathers	
	Bushy	Sparse
A.S. 6362	63	24
,, 6363	71	26
,, 6364	69	19
,, 6365	76	23
TOTAL ..	279	92
Calculated 3 : 1 ..	278·2	92·8

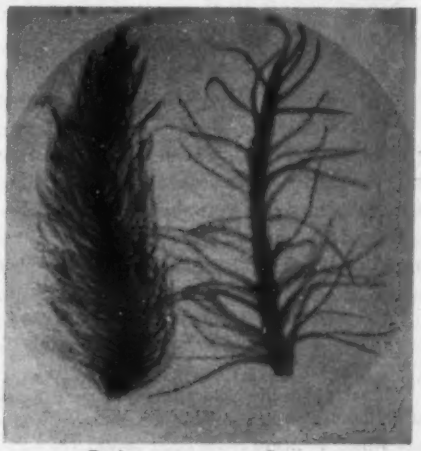
From the above data it will be seen that the normal bushy distribution of stigmatic feathers is a simple monogenic dominant to a sparse distribution, the sparse feathers being



Awn barbs

FIG. 1

about a sixth of the normal in number. In the *S. durra* parent, the stylar and stigmatic areas are about equal. In the *S. coriaceum* parent, the stylar length is greater than the stigmatic length. It was noticed that the denseness or



Bushy Sparse

Stigmatic feathers

FIG. 2

sparseness of feathers was independent of stigmatic length relatively to stylar length.[3]

Thus bushy feathered stigmas and sparse feathered stigmas have a monogenic difference, the former being dominant. Concurrently with the segregation for bushy and sparse distribution of stigmatic feathers, the respective homologous awns have close set and sparse barbs (*vide* illustration). A gene designated SB is responsible for the normal bushy stigma. Gene sb gives a sparse feathered stigma.

G. N. Rangaswami Ayyangar.
A. Kunhi Koran Nambiar.

Millets Breeding Station,
Coimbatore, S. India,
April 8, 1939.

[1] *Ind. Jour. Agric. Sci.*, 1936, **6**, (6) 1314.
[2] *Curr. Sci.*, 1935, **3**, 540–42.
[3] *Ibid.*, 1935, **4**, 176–77.
[4] *Ibid.*, 1936, **4**, 817–20.
[5] *Mad. Agric. Jour.*, 1938, **25**, 123–26.

On the Life-History of *Cylindrocapsa geminella* Wolle[1]

The author followed the life-history of a *Cylindrocapsa*, which was found in Madras and which agreed in several respects with the description of *Cylindrocapsa geminella* Wolle.[2] The alga is filamentous and unbranched and its cells are ellipsoid to sub-rectangular in shape. Each cell has a large stellate chloroplast in the centre of which is imbedded a large pyrenoid (Fig. 1). A single nucleus is situated close to the pyrenoid. The chloroplasts of *Cylindrocapsa* have been variously described in text-books on Algæ as a massive chloroplast or as a massive parietal chlroplast or as a parietal, massive, often ill-defined chloroplast, but a careful examination of the living material shows very clearly that the chloroplast is definitely stellate. During cell division, the pyrenoid first divides into two and then the nucleus divides into two. The nuclear division is very interesting in being amitotic.

Sexual reproduction was observed during two successive years (1938 and 1939). The contents of some cells of the filament escape cut as large, quadri-ciliate motile spores. One spore is formed from each cell. These spores, after swimming for a time, settle down on the filaments of *Cylindrocapsa* or of other algæ in the water and then each one of them immediately surrounds itself with a firm wall. Soon after this, further cell-wall layers are secreted by the protoplast. And the wall becomes lamellate and soon enlarges as a loose envelope round the protoplast which becomes rounded and lies loose in the centre (Fig. 2). This is the oogonium of the alga and the rounded protoplast inside is the single oosphere. The outer gelatinous envelope soon forms a beak-like opening on one side (Fig. 3). In this condition the egg is ready for fertilization.

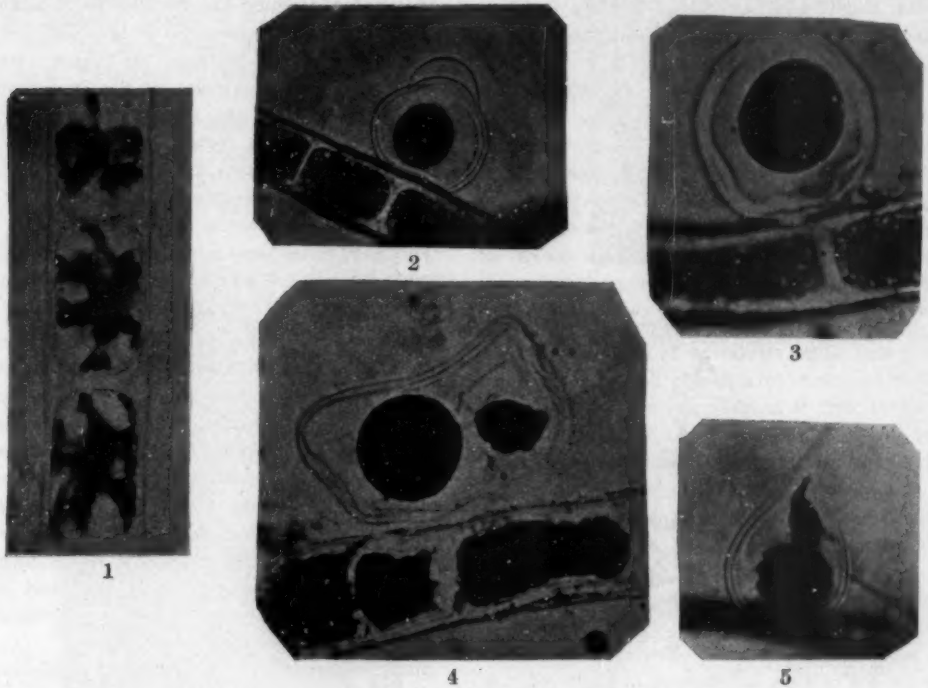
From some smaller cells of the filament smaller swarm-spores are formed. These, except for their smaller size, are quite similar to the previous swarm spore. These also, after swarming, settle down on the filaments of *Cylindrocapsa* or of other algæ in the water and soon each one of them surrounds itself with a definite wall. The contents of this cell then divides into two or four protoplasts which soon escape out as small four-ciliated antherozoids. The antherozoid swims for a time and finally reaches an oogonium and enters through the aperture in the oogonial wall and fuses with the egg (Figs. 4 and 5). Soon after fusion, the egg surrounds itself with a wall.

This type of sexual reproduction was observed repeatedly in the living material. The formation of an oogonium and an antheridium outside the plant by means of motile spores formed from the vegetative cells of the alga is something very unique and not known in any other green alga. The oogonium and the

[1] This paper was read before the Annual Meeting of the Indian Academy of Sciences at Madras, on 20th December 1938.

[2] The alga in its life-history differs in several respects from *C. involuta* and also from *C. geminella*. These points will be described in the fuller paper. The author, however, has tentatively referred the alga to *Cylindrocapsa geminella* Wolle in this note.

antheridium formed by the motile spores must be considered as single-celled female and male plants, respectively. In the case of the male plant there is a certain amount of resemblance to the dwarf males of *Oedogonium*, but there has been no instance of any dwarf female plants so far similar to the one seen here. A certain amount of resemblance is, however, seen in the behaviour of the large ciliated oosphere of *Aphanochæte*. In the case of *Aphanochæte* an oosphere is formed inside the oogonium. This escapes from the oogonium as a large, quadri-ciliated gamete which soon comes to rest somewhere outside the plant. It is then fertilised by a quadri-ciliated antherozoid. The interesting feature here is that the egg is fertilized outside the oogonium. But, in the case of the Madras *Cylindrocapsa*, the motile spore which escapes from the ordinary plant is not the oosphere of the alga, but is merely a spore which forms the single-celled female plant which ultimately becomes the oogonium. So the resemblance between *Aphanochæte* and the present alga does not extend beyond the fact that the egg is fertilized outside the main plant in both the algæ, but the structures that are concerned in the process are not the same in the two algæ. The significance of this will be further discussed in detail in the full paper.



Cylindrocapsa geminella Wolle

FIG. 1.—Cells of the filament showing the stellate chloroplast and the pyrenoid. × 337.
FIG. 2.—Oogonium formed by a motile spore outside the plant. × 205·3.
FIG. 3.—Oogonium before fertilization with the oogonia wall opened at the top. × 1001·5.
FIG. 4.—Oogonium with an antherozoid close to the egg (four cilia seen on the antherozoid). × 819·5.
FIG. 5.—The antherozoid fusing with the egg. × 1001·5.

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May 1, 1939.

A Metal Image of Manjusri

MANJUSRI had enjoyed a chief place in the Buddhist Polytheism. The cult of Manjusri seems to have originated in India but, when it was introduced into China, had taken a different form; and it was from China that the cult had spread to Nepal. In Mahayanism, Manjusri is regarded as a Bodhisattva.[1]

It is difficult to determine the date of the introduction of this deity into the Buddhist pantheon. However, the Chinese pilgrims, namely, Fa-hien, Hiuen Tsang, and I-tsing, speak of the worship of Manjusri in India.

The *Sadhanamala*,[2] a work in Sanskrit, contains *Dhyanas* describing several forms of Manjusri; and the most common representation of this form in sculpture carries the Sword and the Book in its right and left hands.

FIG. 1

A metal image of Manjusri, measuring 2½" in height, comes from Kanchi (Conjeevaram) having been discovered there (I am informed) in a gutter. The pedestal on which this image must have been installed is now lost and the image itself is faintly corroded at the back. Though small, the figure looks beautiful and was probably (judging by its size) under private worship and discarded later by someone.

That Kanchi had been a great centre of Buddhist faith and that many schools of Buddhist philosophy flourished therein are only too well known. A large number of stone images of the Lord have been noticed here but a figure of Manjusri representing a particular type of Mahayanism has not been so far traced. This metal image, therefore, appears to be a valuable archæological find.

One form of Manjusri has the nomenclature of Vak or Vajraraga which is described by Bhattacharya[3] as follows:—

"Vajraraga or Amitabha Manjusri is one-faced and two-armed. His hands are joined in the lap, forming the *Dhyana* or *Samadhi Mudra*. In this respect he is identical with his sire whom he bears on his tongue. But he may be distinguished by the ornaments he wears and by the image of his Sire if represented on the crown. ..... Images of this form of Manjusri are extremely rare in India with the exception of the one at the temple of Bauddhanath in Nepal."

The special features which characterise this image are (1) *Mudra-Samadhi*, (2) *Asana-Vajraparyanka*, (3) Ornaments and Dress.

The image from Kanchi seems to agree well with the description given above of Vak or Vajraraga Manjusri with the exception of an object which the figure holds in its hands. Even in the case of the Manjusri whose figure is reproduced by Bhattacharya, a more or less similar kind of object is visible though unexplained by the author. As regards the Conjeevaram image, the object appears to be a human head which, perhaps, represents the head of Amitabha or the Sire on whom the Manjusri is supposed to concentrate.

Since the provenance of this image is Kanchi we may suppose that Manjusri cult was prevalent in this historic city in the early centuries of the Christian era. The very fact that Kanchi attracted the attention of Vajrabodhi, a Great Worshipper of Manjusri, proves the existence of Tantric form of Buddhism in Kanchi in the seventh century A.D. In this connection it is well to remember the statement of the late Gopinatha Rao who says that the famous Kamakshi temple was originally dedicated to the Tantric Goddess Tara.[4]

C. MINAKSHI.

Madras,
May 2, 1939.

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[1] Hastings' *Ency. of Religion and Ethics.*
[2] *Gaekwad Oriental Series, Sadhanamala.*
[3] *Buddhist Iconography*, (2), p. 18.
[4] *Ind. Ant.*, 44.

Grafting of Apples on *Eriobotrya japonica* Stocks

MR. M. J. THIRUMALACHAR has reported in the March Number of *Current Science* a case of grafting of Apple on *Eriobotrya japonica*. He has figured a successful graft six weeks old.

We wish to mention that successful experiments in grafting of apple on *Eriobotrya* were conducted in the Fruit Nursery attached to Lalbagh in the year 1936. About half a dozen successful plants of 1936 are growing in the Nursery, one of which has put forth a bunch of flowers (Fig. 1). From the observation so far recorded the leaves of the budded apple on *Eriobotrya* is much coarser and the rate of growth slower than that of apple on apple. Further work on the morphological aspects is being pursued. At the Fruit Research Station, Hessarghatta, budding apple varieties on *Eriobotrya* is being conducted on a large scale (Fig. 2). There have been a number of successful takes, as against Mr. Thirumalachar's failure to make the budded plants make much headway.

FIG. 1

FIG. 2

Another contention of Mr. Thirumalachar is that the problem of a suitable apple root-stock in India is to find one which is resistant to the root disease. Our experience is that in addition to the root disease—collar-rot—our real problem is the longevity of the apple and the object in trying apple buds on *Eriobotrya* is to lengthen the life of the apple plant, as *Eriobotrya* is known to live much longer under the conditions obtained in Bangalore.

In Algeria, Pears are said to be regularly budded on *Eriobotrya*. Thus it is not the first time that *Eriobotrya* has been looked upon as a likely stock in pomological work in the warmer countries.

It is in the programme of the Fruit Research Station, Hessarghatta, and the Lalbagh Nursery, to try various Rosaceous stocks for the different varieties of apple. Anatomical work on the nature of the union between the stock and scion is a regular item of work at the Research Station.

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April 12, 1939.

REVIEWS

Background to Modern Science. (Ten lectures at Cambridge arranged by the History of Science Committee, 1936). Edited by Joseph Needham and Walter Pagel. (Cambridge University Press), 1938. Pp. xii + 243. Price 7/6 net.

We have read this book with absorbing interest. We conclude that no praise can be too great for the Editors. Their plan of providing a historical and cultural background to the formal instruction of science will be widely appreciated. It is this aspect of science that clothes it with flesh and blood. Every student of science ought to be fully acquainted with its evolutionary history, the successive stages in the accumulation of knowledge of the facts and phenomena of Nature, leading ultimately to the establishment of at least partial mastery over the forces and factors of the physical environment for the promotion of human civilization and culture. No knowledge can be more significant than an understanding of our origins and development and no study can be more valuable which has led us to a deeper appreciation of the properties and forces hidden in the objective world. An account of the attitude of modern scientific knowledge to the growth of social institutions, to the satisfaction of human needs and aspirations should have a great interest for those engaged in building up a "scientifically planned society".

The Editors have succeeded in their task of presenting the readers with a picture of "the working of the 'cutting edge' of human scientific activity and how it has been at work during the last half century in many different fields", and this picture is an indispensable background for special knowledge. The lectures were composed by F. M. Cornford, Sir William Dampier, Lord Rutherford, W. L. Bragg, F. W. Aston, Sir Arthur Eddington, J. A. Ryle, G. H. F. Nuttall, R. C. Punnett and J. B. S. Haldane.

The book does not preach science. The contributors expound some of the new knowledge and wisdom which man now possesses and it is obvious that the power to make or mar his destiny is also in his hands. The subjects dealt with in the book are "Greek Natural Philosophy and Modern Science; from Aristotle to Galileo; Forty years of Physics; Forty years of Crystal Physics; Forty years of Aromic Theory; Forty years of Astronomy; Forty years of Physiology and Pathology; Forty years of Parasitology and Tropical Medicine; Forty years of Evolution Theory; Forty years of Genetics". This imposing array of subjects dealt with by the most eminent leaders of science must invest the book with an importance, rarely falling to the lot of publications of similar or bigger size.

The Theory and Practice of General Scince. By H. S. Shelton. (Thomas Murby & Co., London), 1939. Pp. vii + 123. Price 3*sh.* 6*d.* net.

The conventional specialised science courses in our High Schools are gradually replaced by a more generalised scientific instruction which will certainly enable the pupils to gain a more rational and comprehensive view of the objective realities of the world around them. This interesting book proposes to give clear and illuminating answers to the questions formulated by the author. "What is this general science? What should be its content? Is it a collection of snippets or a connected course? How should it be taught? What time is required to teach it efficiently? How should the teacher prepare himself for the task? These questions form a wide range of enquiry and they are treated in the book very comprehensively and satisfactorily. Science masters of High Schools will welcome this book, and no doubt will read its interesting and stimulating chapters with avidity. Perhaps those in charge of directing public education and others interested in the advance of education will greatly profit by a perusal of this book and a deeper knowledge of the place of general science in the curricula of secondary education, will lead to a clearer definition of the policy of education and to the provision of adequate finance. Governments are slow to recognise—even if they recognise are slow to act—that science is a great force in the continuous transformation of society in material production and in culture.

Educating for Democracy. Planned and Edited by J. I. Cohen and R. M. W. Travers. (Macmillan & Co., Ltd.), 1939. Pp. xxx + 458. Price 10/6 net.

As a comparison volume to the Editors' previous publication *Human Affairs*, the present work will be welcomed by those who pursue education as a profession as well as by the intelligent public who will find in the twenty-three contributions comprising the book subjects sufficiently wide and varied to instruct and stimulate them. The two editors who are ardent psychologists have succeeded in persuading about a score of leading educational exponents to write a series of brilliant articles on the fundamental problems of the conscious organisation of the educational principles and practice for liberalising human life, founded on social justice and freedom. Education being conceived as a social science, the articles constitute a unitary whole, whose aim is to present the new knowledge and wisdom, necessary to capture and exploit the machinery of mind, as a means for controlling human destiny. The purpose of the book is to emphasise the view-point that education shoud be the hand-maid of democracy, which is understood to be synonymous with scientifically planned human society, in which the needs and aspirations of its members must be the first charge on those governing its affairs. According to the editors, the book "gives a design for living in a free society, alive to the affairs of every-day life".

Whatever may be the official definition of education or the popular conception of its aims, its main purpose is to supplant the natural instincts by the inculcation of the standards of conduct approved by Society. For the attainment of this desirable ideal, Text-books are prescribed, and teachers are employed to expound to the bewildered young men their mysteries of knowledge and wisdom. At the end of this process, examinations are held for the purpose of testing the degree of mental and moral cultivation attained by the young scholars, and upon the evidence given, they are declared as good citizens or as misfits. We forget, however, that the former group have only succeeded in inhibiting their natural anti-social impulses to a greater degree than the latter, and the deposit of knowledge over the aggressive instincts, whether thin or thick, will easily crumble when tests of fear, hate and irrationality are applied during grave national crises. Education is essentially a barter, the exchange of stone-age mentality for mid-Victorian culture and code of morals, and in the nature of things the transaction can never be complete for the sacrifice involved amounts to the surrender or displacement of the whole world of animal inheritance inseparable from the evolutionary history of man. Leaders of education are confronted with the question whether under the influence of education, man has got rid of all traces of primitive anti-social instincts, and it would not do for them to answer that knowledge has enabled them to add to the material comforts and conveniences of society, has diminished the incidence of diseases, and secured greater insurance of public health and longevity and has rendered possible the orderly progress of mankind.

These general reflections are bound to arise from a perusal of any book on Education and they have no particular reference to the work of Cohen and Travers. We agree that the book gives a design for living in a free society and is alive to the affairs of every-day life. Each article is thoughtful, complete and provocative. The reader will find in the book sufficient matter worth reading and pondering over.

Ergebnisse der Enzym forschung. Edited by F. F. Nord and R. Wiedenhagen. (Akademische Verlagsgesellschaft, M.B.H., Leipzig), 1938, Vol. 7, Pp. 437.

This is the seventh volume of the well-known series with which all biochemists are familiar. The high standard which it has maintained has been made possible through the untiring efforts of the enterprising editors who have been able to secure international co-operation in reviewing the most outstanding achievements in the domain of enzyme chemistry.

Sixteen contributors distributed among seven different countries, England, France, Germany, Czechoslovakia, Finland, Sweden and U.S.A., who are responsible for the articles in this volume, secure for this enterprise a status which is manifestly international. Most of the subjects discussed in the volume are either those in the forefront of enzyme chemistry or those which have reached a well-defined landmark. A discussion of the investigations of dehydrogenases by Thunberg, the founder of the methylene blue technique, is both opportune and appropriate. The editors could not have

chosen a better contributor than Warburg to speak on the chemical contistution of enzymes, a field in which he has made fundamental and spectacular contributions. The two articles on sulphatases and nucleases, serve to clarify the position with regard to systems which have received little attention. Helferich's contribution on Emulsin, is an authoritative treatise, covering the researches carried out by himself and his pupils. From Princeton comes a contribution on the preparation of one more crystalline enzyme, carboxypeptidase. Special attention should be invited to the stimulating article of Marrack on Immuno-chemistry and its relation to enzymes.

It is superfluous to commend such a volume as this, which is internationally recognised, widely appreciated and eagerly welcomed by biochemists all the world over.

M. S.

A Manual of Pteridology. Edited by FR. VERDOORN, in collaboration with A. H. G. Alston, I. Andersson-Kottö, L. R. Atkinson, H. Burgeff, H. G. du Buy, C. Christensen, W. Döpp, W. M. Docters van Leeuwen, H. Gams, M. J. F. Gregor, M. Hirmer, R. E. Holttum, R. Kräusel, E. L. Nuernbergk, J. C. Schoute, J. Walton, K. Wetzel, S. Williams, H. Winkler and W. Zimmermann. Foreword by F. O. Bower. (The Hague: Martinus Nijhoff), 1938. With 121 illustrations. Price 24 guilders.

Dr. Verdoorn is well known for his success in inducing botanists in many countries to engage in co-ordinated activities. Here is one more proof of his commendable efforts in this direction. The two sister volumes, the *Manual of Bryology* published in 1932 and the *Manual of Pteridology* now before us, are intended "to provide those working on the Archegoniatæ with a new breadth of view and help them to put their problems and results in a truer perspective". The editor has "urged his contributors to give more space to new ideas than to an academic summary of established knowledge". It would be difficult to claim that this wish has been realised: the work is in the main a summary of recorded facts but as such it is authoritative and up to date. English, French and German are to-day the universally recognised languages of science. The fact strikes one that in this international handbook there is not a single article in French.

The opening chapter, by Professor J. C. Schoute, deals with the general morphology, and this is followed by another chapter by the same author on the anatomy, of the Pteridophyta. Apart from much descriptive matter which by itself is not easy reading, a useful discussion is given of the disputed morphological nature of several organs. Professor Schoute has no room for indecision in these matters that vex other botanists. He has no doubt as to the foliar nature of the sporangium-bearing complex in the Psilotaceæ, and he is equally certain that the rhizophores of *Selaginella*, in spite of their root-like steles, are modified stems. The stigmarian axis is undoubtedly a rhizome, and its "rootlets" probably modified leaves. The dichotomously lobed stem base of *Pleuromeia* is regarded as homologous to the stigmarian axis, so that its attached rootlets would also be modified leaves. But the lobed stock base in *Isœtes* does not seem to offer any analogy with the Lepidophytes; and its roots are clearly true roots. Nor does the condensed base of the stem in *Nathorstiana* appear to have anything to do with the stem base in the Lepidophytes.

S. Williams of Glasgow follows with a chapter on experimental morphology. Perhaps the outstanding feature of this contribution, apart from its clarity of style, is the wholesome reluctance of the author in drawing conclusions from the results recorded. The most hopeful lines of attack are experimental investigations of the physico-chemical aspects of morphology, particularly with the help of hormones; experimental cytogenetics; and, where possible, a correlation of the results thus obtained with the observed facts of palæobotany. In the solution of phylogenetic problems "experiment seems likely to be of very limited service".

The fungous associates of the Pteridophyta receive treatment in two chapters; of these the first, by Mary J. F. Gregor of Edinburgh, gives little beyond a record of occurrences. The significant chapter is that on mycorrhiza by Professor Hans Burgeff of Würzburg. This is an exceptionally well illustrated account of the intimate relations between fungi and the underground organs of vascular cryptogams.

After a brief chapter on galls by W. M. Docters van Leeuwen there follow three chapters, by L. R. Atkinson, W. Döpp and I. Andersson-Kottö dealing with the cytology

and genetics of Pteridophyta. The first two of these contain a mass of descriptive data on the structure of the nucleus, both in the somatic and reproductive cells, in the normal life-cycle as well as in its variations. Numerous illustrations are reproduced from original sources. *Inter alia* the cytological aspect of apogamy and apospory is discussed; also polyploidy and aneuploidy. The chapter on genetics by Andersson-Kottö shows that the modern ferns present rich material for genetical observations. An advantage over the angiosperms is that the gametophytic generation is well developed; it can be kept almost indefinitely by subdivision and employed for repeated experiments with self and with cross fertilisation.

Du Buy and Nuernbergk, in a chapter devoted to growth and movements, discuss, among a variety of subjects, the influence of hormones on the development of prothallia; the importance of environmental conditions, especially of light, on the gametophyte; the phototropism and geotropism of rhizoids and leaves; regeneration and wound reactions; hygroscopic movements in the ferns and horsetails; and the tactic movements of spermatozoids.

From the biochemical and metabolic point of view scarcely another group of plants has been so little investigated as the Pteridophyta. A useful chapter by Wetzel brings together in 34 pages a quantity of data concerning the constitution of the cell membrane and cell contents, as well as experimental data on the various physiological processes, particularly assimilation and respiration.

The ecology and geographical distribution of modern members of the group occupy three chapters, covering about 90 pages. H. Gams deals with the ecology of extratropical pteridophytes and Holttum with that of the tropical forms, while Hubert Winkler treats of the purely geographical aspect. There is an inevitable overlap in the scope of the three authors, but they bring together much scattered material of interest and give a number of interesting photographs of tropical ferns.

Hirmer gives a condensed account of the distribution in time and space of the various genera of fossil Pteridophytes. As usual he is up to date and accurate but has overlooked that *Azolla* occurred in the Tertiaries of India and England and in the Pleistocene of Holland and Russia. Kräusel gives a brief article on the Psilophytales, largely based on his own work. It is useful to see in the brief compass of these two authoritative chapters by Hirmer and Kräusel a large number of genera (many of them recently created and known to most botanists only by name) placed in definite groups, even though further knowledge may make regrouping desirable. One would have welcomed a few sketches showing the general appearance of the more important of these genera.

Walton and Alston give a compact scheme of classification for living and extinct lycopods and this is followed by two further chapters by Hirmer on the Psilotaceæ and on the Articulatæ. The modern ferns are classified by Christensen and the fossil ferns again receive a brief treatment from Hirmer. The *Pteridophyta incertæ sedis* include that intriguing group, the Cladoxylales, which until recently most authors preferred to regard as gymnosperms.

The concluding chapter (60 pages) is by Professor W. Zimmermann of Tübingen who has bestowed much careful thought to the difficult questions of phylogeny. After giving a rapid review of the literature he surveys the sporophytic generation of the early Pteridophytes, first in the morphology and anatomy of its vegetative organs and then in its reproductive organs. Numerous diagrams illustrate the author's views, some of which we know from his important published works. There is much originality exercised in tracing the course of evolution in leaf form, in the relation between leaf and stem which in turn must largely influence the evolution of their steles, and lastly in the relation between leaf and sporangium. These problems are so puzzling to students of morphology that no fundamental agreement can be foreseen in the near future. Professor Zimmermann, at any rate, is one of the few recent botanists who have made a comprehensive essay into the possible ways in which the tangled mass of facts can be fitted into theory. New discoveries in palæobotany irresistibly tickle the imagination but they equally often put a damper on pet theories. Should we, therefore, stop theorising or should we, like Professor Zimmermann, go courageously forward? On the whole, if the aim is to stimulate thought, we would prefer the latter alternative, provided one knows where to apply

the curb. For this reason Professor Zimmermann deserves the thanks of his colleagues, even though they may not agree with all his views.

Reviewing the *Manual* as a whole, several commendable features emerge. Its greatest merit is that it brings into one volume a variety of authoritative articles on many different aspects of the group. There is some evidence of a lack of co-ordination; for example, some avoidable overlapping, and the lack of a single consolidated but classified Bibliography for handy reference. The printing is excellent, misprints are rare, and the quality of illustrations is, on the whole, very good although the quantity varies considerably in the different chapters.

Considering everything the *Manual of Pteridology* is a welcome addition to the literature and botanists have good reason to be grateful to Professor Verdoorn.

B. SAHNI.

A Text-Book of Applied Hydraulics. By Herbert Addison. Second Edition, revised and enlarged. (Chapman & Hall, Ltd., London), 1938. Pp. 435. Price 21/-.

It is a valuable treatise on Hydraulics. The book is useful for beginners as well as for students of advanced Hydraulic Engineering. It is divided into two parts. The first part deals with the fundamentals of Hydraulics, i.e., static and dynamic pressures of liquids, flow of water over notches, weirs, through pipes and in channels.

The different principles have been dealt with in a very clear and intelligible manner. Only selected and important formulæ are given. This is a very good point in the book. Usually books on Hydraulics contain so many mathematical formulæ that the beginner is left in confusion. The characteristics of viscous, turbulent and shooting flow are explained in detail in a very clear manner.

Regarding Part II of the book, i.e., practical application, the most important chapters are on the hydraulic turbines, their construction and working and the pumping machinery. These pages contain a lot of information useful to Electrical Engineers.

The discussion of flow over weirs under free fall and under highly submerged conditions and also of the actual operating conditions of weirs, barrages and regulators is very interesting and highly useful to Irrigation Engineers.

The last chapter deals with the instruments such as pittot tubes, current meters, venturi meter and Helix meter for the measurement of velocity, rate of discharge and direction of flow.

The book on the whole is a useful contribution to Hydraulics.

One or two points are, however, suggested. In view of the recent advances made on the problem of subsoil flow, it is necessary to devote at least one chapter to the flow of subsoil water and its application to the design of dams, weirs and barrages on sand foundation. Secondly, the value of the book will be very much enhanced if frequent references are made to model results with a view to elucidate certain points. The author has made occasional references but this is not enough considering the tremendous amount of important research work carried out on hydraulic models.

H. L. UPPAL.

Plant Physiology. By Edwin C. Miller. Second Edition. (McGraw-Hill Publishing Co., London), 1938. Pp. 1201. Price 45/-.

Seven years can be considered a short period for the second print of a volume like Prof. Miller's *Plant Physiology*. It therefore bears testimony to the usefulness of the book which must have proved a valuable guide both to students and research workers alike.

A few years ago the need for a suitable text-book on plant physiology, embodying the rapidly advancing knowledge on the subject, was keenly felt both by teachers and students, and Professor Miller was the first to satisfy the need by bringing out the first edition of the book in 1931. The book published by the author went beyond the range of a text-book and it was welcomed by research workers in the field of plant physiology. It served a twofold objective; a text-book as well as a reference book on account of the up-to-date references to literature.

As a text-book, it has many good points. It contains valuable summaries of the existing knowledge on all fundamental life processes of the plant, like respiration, protein synthesis and the intake of salts. Current views and theories of the mechanism of some processes are described in a lucid

style with arguments and experimental evidences for and against each concept. The theories of the ascent of sap are ably discussed and an impartial account of the experimental evidence on the conflicting views regarding the path of conduction of elaborated food substances in the plant's body is given.

As the book is perused, one cannot help feeling that at many places no effort is made to link up the findings of different workers on a particular topic in a coherent manner. It seems as if the original papers are mentioned merely for the sake of mentioning. But this defect cannot lower the value of the publication as a text-book as such portions are probably not intended for students taking degree courses in Botany. They may be intended for the benefit of the teachers and research workers who can, if required, look up the original papers. The author has also made it clear in the Preface to the second edition that he has tried to present data impartially without putting his own ideas and that is a commendable attitude to adopt when one has to deal with a very large number of topics.

Professor Miller's book is as much agronomical in its contents as it is physiological wherein pure and applied physiology are treated side by side. This is an important feature of the book and, therefore, it should be of great value to those engaged in agronomical work. A knowledge of plant physiology is essential for those who tackle agricultural problems in order to understand and interpret rightly the plant's behaviour under different conditions of field experimentation. Professor Miller is himself engaged in agronomical research and has thus realized the necessity and importance of physiological knowledge in agricultural science. He has, therefore, kept this viewpoint before him while writing this book.

The first edition of the book covered 900 pages, while the second edition is greatly enlarged and covers 1,200 pages, of which 300 pages are devoted to Bibliography and Index. Many new topics like the physical and chemical properties of the cell wall, theories of cell structure, vitamins, growth hormones and vernalization, are newly added. The chapters on "the elements absorbed by the plant" and on "the processes of growth of plant" are enlarged and more literature is incorporated in them. Thus the second edition of the book marks a great advance on its first edition and has made up the deficiencies in the latter.

The book is well written and the huge mass of data is well sifted, segregated and arranged. To be brief, it is a good book for the Physiologist and the Agronomist and every institution and Experimental Station should possess it for the benefit of its teachers and researchers.

R. H. DASTUR.

Plant Physiology. By Nicolai A. Maximov. Edited by R. B. Harvey and A. E. Murneek. Second English Edition: Translated from the Russian by Dr. Irene V. Krassovsky. (McGraw-Hill Publishing Co., London), 1938. Pp. x + 473. Price 24*sh.*

The second edition of this well-known handbook of plant physiology is welcome as a text-book as well as a teacher's handbook. Advanced students are already familiar with the writings of "The Plant in Relation to Water". This handbook brings the author within reach of the undergraduate. The subject is arranged in such a manner as "to acquaint students with the general physico-chemical foundations of the plant, with its chemical composition, and with its mechanisms of digestion and metabolism. After these introductory chapters, we pass to a discussion of some of the more important vital functions such as respiration and growth, which are most clearly manifested already from the first growth stages—the germination of the seeds."

Up-to-date knowledge has been introduced in a most readable manner. Each chapter is almost autonomous and yet all of them have been threaded together into a complete whole. The physiological principles of well-known agronomic and horticultural practices have been elucidated in different chapters of the book. This will make the book of wider appeal than only to the student of 'pure' plant physiology.

In short this is a handbook which will be of use to the student and teacher alike.

P. P.

District Development Scheme. By Sir M. Visvesvaraya, K.C.I.E., LL.D. (The Bangalore Press), 1939. Pp. vi + 63.

The appearance of this provocative brochure with constructive proposals for district development is opportune. Young men fresh from colleges are exhorted to go to

rural areas. Provincial ministers exhibit a tender solicitude for the improvement of villages. The students are bewildered. The ministers make speeches. Under the circumstances the book must be deemed to perform a distinct public service.

Sir M. Visvesvaraya is a distinguished administrator, whose knowledge of rural affairs is as intimate as his experience is rich and varied. He has put forward concrete schemes, fortified in every detail by definitely practical suggestions, which even a raw graduate can work, provided he is inspired sufficiently by a missionary zeal and true patriotic fervour.

We have perused this little book with diligence and care. We have concluded that the safety and progress of the masses cannot be entrusted to the hands of a few clever officers, without the intelligent and cordial co-operation and sympathetic understanding of their policies and projects on the part of the people. The book expounds the thesis that the co-operation of the village people is an instrument of immense power, which, wisely directed, would enlarge their personal lives, by stimulating increased output and by raising the standard of their economic efficiency. The author in his inimitable way emphasises the fact that if the citizens of to-morrow are to choose wisely, the village and the district must become keenly alive to the technical forces and the new powers which will shape and determine their ultimate destiny. In the three important chapters, "Aids to Development", "Policies and Implications" and "A Concrete Programme", the author has developed his schemes of planned organization, whose aim is to enable the village people to strive forward to self-consciousness, and to discover to them the resources for the enrichment of rural life and its activities. So the mind and will of every officer in charge of district administration and of every public-spirited citizen should be focussed on the fundamental fact that technical opportunities, close co-operation and planned organization and definite schemes of development should be their concern, if the country as a whole should progress and take its place among the more advanced nations. According to Sir M. Visvesvaraya knowledge and experience should be habitually considered in terms of human advancement, and both should be presented to the people as a bag of tools for promoting the material and cultural basis of the good life. We hope that the book will be accorded a warm reception, and we confidently recommend this authoritative contribution to "Planned Development" to the study of all good citizens and provincial administrators.

Über ein neues mechanisches Gewebe (Helicenchym) in den Blättern der *Cornus*-Arten. By Riukiti Kano. With 1 Plate and 2 Text-figures. (*The Botanical Magazine*, Vol. LI, No. 612), 1937.

In this brief but well-illustrated paper the author describes a new type of mechanical tissue to which the name *helicenchyma* is given. It is found in the leaves of *Cornus* species (*C. kousa*, *C. florida*). The tissue consists of spirally thickened but *not lignified* prosenchymatous elements with the thickening bands much broader than in spiral vessels. The bands are attached to the cell wall by a narrow base. The tissue occurs in strands running longitudinally near the leaf-margin and extending basipetally into the petiole in two marginal strands. It would be interesting to investigate other species of *Cornus* and other genera of *Cornaceæ* to see if this tissue occurs there also.

B. SAHNI.

Sampling and Analysis of Carbon and Alloy Steels. Methods of the Chemists of the Subsidiary Companies of the United States Steel Corporation as revised to 1937. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1938. Pp. 356. Price $4·50.

During recent years the great variety of steel products made under exacting specifications demand rapid, concise and accurate methods of analysis both during their manufacture and use and the present volume is particularly welcome to the analytical chemist in this direction.

This book replaces two former booklets dealing with the sampling and analysis of plain carbon steels and of alloy steels. The methods for analysis are grouped by elements and are limited to those which are considered the most practicable and satisfactory. The book starts with a detailed account of the methods of sampling for ladle, semi-finished and furnished products and after outlining the quick identification tests and treating chemical separations in two separate chapters, goes on to consider the

various elements individually. A critical discussion is given in the Appendix on the methods of determination of sulphur or carbon and sulphur by combustion in oxygen and three methods developed by the chemists of the Corporation are given in detail. In another Appendix brief outlines are given for estimation of oxygen or oxygen, hydrogen and nitrogen by the vacuum fusion and hydrogen reduction methods and for oxides and other non-metallics by the iodine, chlorine, electrolytic solution and the acid solution methods.

Practically all the elements entering into steel have been covered. Of particular interest is the outline for estimation of total aluminium, metallic aluminium and aluminium oxide in steel. There is no reference to methods for the determination of lead which is now being used in free-machining steels. This appears to be an omission considering that even rarely occurring elements, boron, beryllium and cerium are not overlooked.

The use of perchloric acid is strongly advocated throughout the book. Despite the numerous advantages of this reagent its use is attended not without a certain hazard and the necessary precautions required to avoid explosions have more or less stood in the way of its general application.

Some of the well-known European standard methods of works analysis such as the gaseous volumetric combustion method for carbon determination by the Strohlein or similar apparatus, the volhard-woulf method of determination of manganese in high manganese steels, basic acetate separation of iron, etc., do not appear to have been adopted by the Chemists of the Corporation. Some of the methods described in the book appear to be somewhat long by modern works standards, but where highest precision is necessary the recommendations are no doubt justified.

The book is well printed and presented and contains very few printers' errors—those that have come to the notice of the reviewer are page 87, line 39 "iron"; page 308, line 10 "ammonium"; and page 309, line 22 "NaOH". There is no Alphabetical Index, but the Table of Contents is extensive. The book should find a useful place in the shelves of iron and steel chemists.

N. SEN.

The Living Body, A Text-Book in Human Physiology. By Charles Herbert Best and Norman Burke Taylor. (Chapman & Hall, Ltd., London), 1939. Pp. xxii + 563. Price 18*sh.* net.

According to the authors the book is primarily intended for those students who wish to obtain an elementary knowledge of the physiological processes occurring in the human body. The object is therefore to provide for the requirements of the college course, embracing those of the nursing schools as well as those of the dental and agricultural students. The claims of the medical students have not been forgotten. As a text-book in the physiological instruction it is very serviceable, and it forms an excellent basis for those desiring advanced courses leading to experimental investigations. The book is written in a clear and easy style and is profusely illustrated with figures. The treatment of the subject-matter follows the usual orthodox method. The chapters on digestion, metabolism and nutrition, the endocrine glands and the physiology of nerve and muscle and the nervous system embody information derived from the recent advances in our knowledge. But the last chapter dealing with the physiology of reproduction might have received a fuller treatment, with references to the fundamental principles of genetics and heredity. In an elementary text-book of this character, one would naturally expect to find a chapter devoted to the consideration of personal hygiene and public sanitation which legitimately fall within the scope of physiological text-books. Every student must possess a fairly decent and correct knowledge of the origin and development of man, the functions of the organs in health and in disease, the mechanism of inheritance of characters and the imperative necessity of hygienic habits so necessary in the interests of the individual concerned and of the society. However the book provides the ordinary requirements of the college students who will doubtless greatly appreciate the purpose which it is intended to serve.

The Rock-skipping Fishes of the Blenniid Genus *Andamia* from the Andamans

ON the rock-bound and coral boulder-strewn coasts of the Andamans are little-known fishes called the Blennies and Rock-skippers living in shallow rock-pools or on the rocks between tide-marks subject to the action of breakers. The family Blenniidæ to which the Rock-skippers and Blennies belong has a wide distribution in tropical and temperate seas. Their small size and unattractive sombre colours, and their being of no economic importance have attracted very little attention to the members of this family in spite of their wide distribution. The Blennies and Rock-skippers are easily recognised by their slender elongate body, strongly developed fan-shaped pectoral fins near the neck-region, the much-reduced more or less fleshy ventral fins, the long and continuous dorsal fin, and the smooth scaleless body. The males of certain species have fleshy crests on the head. In an excellent paper on the Ecology and Bionomics of the Blenniid Fishes of the genus *Andamia* of the Andamans, published in the *Records of the Indian Museum*, XL, pp. 377–93, pls. viii–x (1938), Dr. H. Srinivasa Rao has made a valuable contribution to our knowledge of the little-known habitats and habits of two species of *Andamia*, one of which is described as new to science by Dr. S. L. Hora (*loc. cit.*, pp. 393–400). The two species of *Andamia* live in the same localities in situations which are only a few feet apart, the older species, *Andamia heteroptera*, in crevices and fissures of rocks or on exposed surfaces of isolated rocks swept by waves or kept constantly moist by the spray from the waves, and the new species, *Andamia raoi*, on the face of rocks exposed to the full force of the breakers from the open sea. The latter species is less well-adapted to a terrestrial existence than the former which is capable of living out of water during the low-water period with only a trace of moisture retained in its minutely corrugated skin. Both the species live in groups of not less than four or five, often in larger groups of ten or more. In open bays studded with rocks or coral boulders constantly bathed by waves, *A. heteroptera* keep moving with the tides jumping on to rocks not completely submerged by the sea. The dislodgement of the fish from their positions on the rocks by the powerful currents and waves is prevented by the action of a curious fleshy cup-shaped sucker on the lower side of the chin and by the fan-shaped pectoral fin. Besides the active movements of the fish such as skipping, skimming and swimming, the author describes its progression on rock-surfaces by the flexure of its tail, and various other curious voluntary movements.

The Rock-skippers feed mainly on minute algæ growing on rocks which they scrape with the help of their fine golden yellow teeth. The great length of the intestine shows that they are vegetable feeders.

The study of the behaviour of the ever-active Rock-skippers in their natural environment having presented considerable difficulties, the author succeeded in keeping them in aquaria for periods up to a month and observing them under various experimental conditions to which he subjected them in the Laboratory. These fish, it was observed, could not survive desiccation for more than three hours as when the moisture on the skin dried up they began to collapse. The author has pointed out that the minute ridges and grooves on the head, operculum and parts of the body may serve to retain moisture for a much longer period than if the skin were smooth. Although the fish bask in the sun in their natural haunts for short periods, it would appear that the moisture content of the skin determines the period up to which they can suffer desiccation. Nor can the fish survive prolonged immersion in the sea-water as atmospheric air, not air dissolved in water, is essential for their life under the conditions prevailing in the intertidal region. The Rock-skippers although terrestrial in their habits are fully

adapted for aerial respiration in the presence of moisture, but under adverse conditions can remain alive for short periods through aquatic respiration in which the organs of aerial respiration seem to subserve aquatic function as well. The spacious opercular chamber and the well-developed gill-lamellæ and pseudobranch appear to be the important factors concerned in this increased capacity for aerial respiration. The gradual dilution of sea-water in which the fish live has little effect on them, but in fresh water they show considerable distress and die in about two hours.

The breeding season of *Andamia*, judging from the occurrence of young ones in nature throughout the year and of eggs under laboratory conditions from September to March, seems to be fairly extended and almost continuous. Some of the stages of embryonic development observed in the Laboratory have been described.

The most interesting point in the observations recorded is that, of the several species of Blenniid fishes which inhabit the intertidal region in the Andamans, two have reached a higher stage in the evolution of the air-breathing habit by leaving the relatively stable environment of the rock-pools and acclimatising themselves to the unstable but better aerated conditions of the spray and surf which bathe the rocks on which they live. Of these two species, *Andamia raoi* occupies a lower rung in the ladder of evolution as it is unable to live far away from the open sea while *Andamia heteroptera* has advanced further in its adaptation to a relatively more terrestrial habitat.

OBITUARY

Dr. T. S. Narayana, M.Sc., Ph.D.

DR. T. S. NARAYANA comes of a family of reputed scholars.—His father is Mahamahopadhyaya Kalaprapurna Dr. Tata Subbaraya Sastri of Vizianagaram. Educated at the Maharajah's College, Vizianagaram, and the Hindu University, Benares, he worked for three years at the Indian Institute of Science, Bangalore, as a Madras Government Research Scholar under the direction of Prof. H. E. Watson. Thereafter he did research in the laboratories of the Andhra University and was serving as a Lecturer in Chemistry in the P. R. College, Cocanada, at the time of his death.

Dr. T. S. Narayana

His published work relates to the Budde Effect in Halogens and is very widely appreciated—extensive references to it are to be found in recent books on Photochemistry like Plotnikov's "Allgemaine Photochemie". He was a very gifted experimenter, and a man of wide learning, not a narrow specialist. His death at the premature age of 32 has removed from our midst a physical chemist of great promise, a skilful experimenter, a popular teacher and above all a very genial friend.

Mineral and Nitrogen Content of Some South Indian Pasture Grasses

By (the late) Dr. A. S. Menon

(University Biochemical Laboratory, Chepauk, Madras)

OF the inorganic constituents constantly found in the animal body the following are now known to perform important metabolic functions: iron, calcium, magnesium, manganese, copper, sodium, potassium, chlorine and iodine. Their indispensability in nutrition is well recognised in practice, in the scientific feeding of farm animals in European countries. But as Sir A. D. Hall[1] has written: "In various parts of the world, cases have been found from time to time of deficiency diseases in grazing live-stock due to the lack of particular minerals in the soil and consequently in the herbage. As a rule, these troubles are found in the old countries only through long-continued grazing of uncultivated pastures, or in the newer countries where grazing has been attempted without consideration of the specific deficiencies of the soil." Both these conditions are prevalent in India and there is reason to believe that malnutrition leading to high mortality, sterility, and low milk yield due to mineral deficiency in pastures is widespread in India. (For a summary see Orr.[2]) The nutritional efficiency of Indian pastures appears, however, to have been little investigated from this point of view. Aiyer and Kayasth[3] working on the mineral composition of fodders in the Central Provinces and Bihar found that the grasses grown in these areas are deficient in phosphorus and calcium. The calcium, phosphorus and nitrogen content of certain varieties of hay and straw have been recorded by Warth, Viswanath Iyer & Krishna Ayyar,[4] and Viswanath Iyer & Krishna Ayyar.[5] Ramiah[6] has made a study of the seasonal variations in the mineral and nitrogen content of spear grass.

In the present investigation a comparative study has been made of the mineral and protein contents of some common grasses from the Madras City on the east, and Malabar on the west coast of the Presidency. The two areas

TABLE I

Mineral content in terms of dry weight

Variety and place	Silica-free ash %	I γ/100 gm.	Cl %	CaO %	P_2O_5 %	Fe %	K_2O %	Na_2O %	N %
Madras									
Cyanodon dactylon	8·24	84·0	0·675	0·605	0·501	Traces	1·907	0·332	2·20
Panicum ramosum	6·25	15·4	0·868	0·948	0·682	0·102	1·832	0·243	1·41
Setaria verticillata	10·36	118·0	1·837	0·564	0·512	0·059	2·64	0·413	2·96
Chloris barbata	4·59	..	1·480	0·896	0·578	Traces	1·093	0·210	2·40
Ergrostis tenella	3·96	69·0	0·571	0·493	0·613	Nil	1·441	0·162	1·02
Ergrostis pilosa	3·02	16·4	0·214	0·435	0·411	0·067	1·722	0·198	1·71
Malabar									
Cyanodon dactylon	3·89	15·0	0·349	0·326	0·356	Traces	1·510	0·285	0·89
Panicum ramosum	4·44	30·0	0·363	0·132	0·358	Traces	..	..	1·40
Andropogan pertusus	6·71	46·0	0·553	0·515	Traces	Traces	1·831	0·222	1·59
Rice Straw (i)	4·50	11·0	0·615	0·325	0·096	0·037	1·690	0·202	0·35
Rice Straw (ii)	2·20	11·0	0·384	0·248	0·027	0·077	1·262	0·154	0·45
British Isles (From Orr, 1929)[2]									
Cultivated pasture	6·64	..	0·95	1·00	0·74	..	3·18	0·25	2·83
Natural pasture	5·85	..	0·64	0·65	0·67	..	2·66	0·37	2·50
Poor hill pasture	5·49	..	0·30	0·56	0·60	..	2·60	0·41	2·54

present striking differences not only in climatic and physical features, but also in the quality of the live-stock, the cattle on the hilly wet regions of the west coast where green grass is available practically throughout the year being notoriously poor in quality both in size and milk yield compared to those on the dry eastern plains; a mineral deficiency in the soil caused by the heavy rains and reflected in the composition of the herbage provides an extremely probable explanation of the poor quality of the Malabar cattle.

The Madras grasses were obtained from the outskirts of the City and the Malabar samples either from Kollengode (a hilly tract near Palghat or from Calicut. The samples were cut in the months of August and September immediately after the grasses had come to flower. Identification was kindly carried out by Prof. K. Ekambaram of the Presidency College, Madras.

The following constituents were determined on nine common grasses and two varieties of straw: silica-free ash, iodine, chlorine, calcium, phosphorus, iron, sodium and potassium. Determinations of nitrogen were carried out at the same time as the protein content is also known to be a factor dependent on the state of the soil.

The methods of analysis were those of the Association of official Agricultural Chemists (1935) with the following exceptions: iodine was determined by von Fellenberg's method as described by Harington[7], nitrogen according to Pregl, and phosphorus according to Fiske and Subbarow.[8]

Conclusions

Taking into consideration only the most important constituents, *viz.*, calcium, phosphorus, potassium, sodium, silica-free ash and nitrogen for which standards of comparison are available, it is obvious from Table I that all grasses analysed are poor in quality, only one of the samples, *viz.*, *Panicum ramosum* from Madras showing a mineral content even approximately equivalent to that of good quality natural British pasture. This species contain adequate amounts of silica-free ash, calcium, phosphorus and chlorine, but is deficient with respect to potassium, sodium and protein. The deficiencies in *Setaria verticillata* are such that this grass would be a suitable supplement to *Panicum ramosum*.

Comparing the grasses from the two localities with each other the west coast varieties are seen to be very much inferior in essential minerals to those grown in Madras; this is strikingly brought out in the case of the two species *Cyanodon dactylon* and *Panicum ramosum* which are common to both groups. The Malabar grasses are particularly deficient in calcium, phosphorus, iodine and protein.

The two kinds of rice straw from Malabar are characterised, as was to be expected, by a mineral content which is extremely low compared even to the grasses from the same locality.

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[1] Hall, Sir A. D., *The Feeding of Crops and Stock*, (John Murray, London), 1937.

[2] Orr, Sir J. B., *Minerals in Pastures* (Lewis, London), 1929, p. 112.

[3] Aiyer and Kayasth, *Agriculture and Live-stock in India*, 1931, **1**, 526.

[4] Warth, Iyer and Ayyar, *Ind. J. of Vet. Sci. and Anim. Husb.*, 1932, **2**, 325.

[5] Iyer and Krishna Ayyar, *ibid.*, 1934, **4**, 108.

[6] Ramiah, P. V., *ibid.*, 1933, **3**, 65.

[7] Harington, *The Thyroid Gland*, Oxford University Press, 1933.

[8] Fiske and Subbarow, *J. Biol. Chem.*, 1925, **66**, 375.

Effective Phosphates in Cane Juices

By S. N. Gundu Rao and Kripa Shankar

(Imperial Institute of Sugar Technology, Cawnpore)

ALTHOUGH the importance of the phosphate content of juices in determining their behaviour towards clarification is generally recognised, the exact phosphate requirements reported by different authors vary within wide limits (Walker,[1] McAllep and Bomanti[2]). Some have concluded (Lanier[3]) that the initial colloid content is more responsible for the efficiency of clarification than the phosphate content itself.

In Natal, where the juice colloids are high and the soil deficient in phosphates, the P_2O_5 content of juices is raised to 0·05–0·06 per cent.[4] to secure good clarification. The work of Keane and Hill[5] on the filtrability of raw cane sugars, of Carrero[6] on P_2O_5 contents P.O.J. 2878 juices, of Beater[7] on South African juices and of McRae[8] on the nature of the phosphates present, shows that the entire phosphorous in the juices is not available for clarification. The authors believe that it is only the phosphate which is in true solution or which gets into solution on heating which reacts with the added lime to form the calcium phosphate precipitate; this portion of the phosphate is known as the *effective phosphate*.

The Separation of 'effective' and 'non-effective' phosphates.—The 'effective' phosphate was dialysed out through a cellophane membrane, at 80° C. against distilled water, employing a muslin-filtered sample of juice (50 c.c.) obtained by crushing in a three roller vertical mill, under moderately heavy pressure. 50 c.c. of the juice is then separately analysed for total phosphates.

The dialysate in the beaker is collected and

TABLE I

	Variety	Total P_2O_5 gm./litre juice	Dialysable P_2O_5 (Effective P_2O_5)	
			P_2O_5 gm./litre	% Total P_2O_5
I (*a*)	CO. 312 ..	0·5850	0·5446	93·09
(*b*)	CO. 231 ..	0·4284	0·4149	96·85
II (*a*)	CO. 312 ..	0·5874	0·5754	97·96
(*b*)	CO. 331 ..	0·4751	0·4648	97·83
III (*a*)	CO. 312—			
	Top ..	0·6076	0·5861	96·46
	Bottom ..	0·8150	0·7875	96·63
	Whole ..	0·6942	0·6761	97·36
	CO. 331—			
	Top ..	0·5116	0·4984	97·42
	Bottom ..	0·7505	0·7370	98·20
	Whole ..	0·6130	0·5998	97·85

replaced by fresh distilled water daily in the initial stages and later on, on alternative days. The dialysis was continued for 7 days, with daily changes of water; all the dialysate was collected, concentrated, evaporated to dryness with a few drops of calcium acetate, ashed and the P_2O_5 estimated gravimetrically by precipitation as ammonium phosphomolybdate. The results obtained with two varieties, on different dates, on the whole juice and juices from top and bottom portions are given in the table.

The above figures reveal that in the varieties examined the effective phosphate is more than 95 per cent. of the total phosphate. This is in disagreement with the results of most of the earlier workers, who obtained by their methods 50–70 per cent. of the total phosphates as possibly being available for defecation. It will also be noticed that the effective phosphate is more in the bottom juice than in the top juice. Whether these differences are common to all the Indian varieties and at different periods of growth or due to milling conditions or to defects in the methods of determination—these are factors now under investigation.

[1] Walker, H., *Ind. Eng. Chem.*, 1923, **15**, 104.

[2] McAllep and Bomanti, *Hawaiian Planters' Record*, **26**, 122.

[3] Lanier, "Process," *4th Annual Conf. of Association Sug. Tech.*, Cuba, p. 93.

[4] Farnell, *Int. Sug. Jour.*, 1929, p. 149.

[5] Keane and Hill, *Ind. Eng. Chem.*, 1931, **23**, 421.

[6] Carrero, *Rept. Agric. Expt. Station*, Puerto Rico, Mayaguez, 1931, p. 11.

[7] Beater, *Proc. South African S. Tech. Association*, 1937, p. 82.

[8] McRae, *ibid.*, 1929, p. 54.

Chemical Reactions Involving Solids

THE structural elements of matter in a solid possess but little mobility at ordinary temperatures, compared to a fluid state, so that one would on superficial considerations even hesitate to regard solids, as such, to be involved in chemical reactions. Indeed this concept prevented for a remarkably long time any appreciable interest being taken in the chemistry of the solid state, although technical processes and particularly work on metallography had shown that under favourable conditions solids do possess a characteristic reactivity. This chemical reactivity of a solid is in particular evident when the other reacting component is a fluid, as in the combustion of carbon, reactions of graphite, reduction of oxides, etc. Reactions in which solid phases are exclusively taking part are also not uncommon: only, these cases are to be met with in different regions of chemical studies such as metallography, solid solutions, and Industrial Chemistry, and thus they escaped a general correlation. Consequently the principles underlying the reactions of solid bodies are very much less known and understood than those relating to reactions in the gaseous phase. The first important monograph on chemical reactions involving solids, "Diffusion und Chemische Reaktion in Festen Stoffen" by Prof. W. Jost, appeared in 1937. The 86th Symposium* organised by the Faraday Society in April 1938 has now helped to bring together various aspects of the subject, for a general discussion.

* *Trans. Farad. Society*, Part 8, 1938, pp. 821, 1085.

It is but natural that the general physical principles underlying these reactions should come up first for consideration. In the first two papers by N. F. Mott and J. C. Slater, the energy levels in crystal lattices, and the motion of electrons and of "positive holes" are discussed, and it is explained how the "excitation" can be transmitted over finite distances by the transfer of energy from one atom to the next. Succeeding papers deal with the conduction, diffusion, and chemical changes in solids. In the phenomena of electric conduction, and in a number of reactions involving diffusion processes, it is interesting to study the mechanism of the movement of the material ions. It is generally regarded that these movements are possible when there are deviations from the strict order of an ideal lattice. According to Wagner, some ions can exist interstitially within the normal lattice, and some positions of the normal lattice may be vacant. Motion is then possible by the jumps of the ions into the neighbouring vacant points or into the neighbouring interstitial positions. When the temperature is not too low, there is a thermodynamic equilibrium of the interstitial ions and the vacant places with the whole lattice. The energy of disorder in the ionic crystals has been discussed by W. Jost. In another interesting paper by J. D. Bernal, on the geometrical factors in reactions involving solids, it has been emphasised that the one common principle which runs through the whole field of such reactions, is the tendency to preserve crystal orientation

and atomic positions as little changed as possible.

The other contributions to this symposium, which are studies of specific reactions, are grouped as Part II and under three sections: (A) Photochemical reactions, (B) Chemical decomposition of solids (including detonation) and reactions between solid phases, and (C) Reactions of solids with gases and liquids, with particular reference to solid carbon.

Photochemical processes proceeding within the simplest of solid substances, namely, the halides of alkali metals, are of fundamental interest, and crystals of greatest chemical purity can be prepared and investigated photochemically. R. Hilsch and R. W. Pohl have proceeded further by using these crystals as solvents for substances of a similar chemical nature, and observing the photo-reactions in the latter. Thus KH in solid solution in KBr decomposes upon absorption of one light quantum ($\lambda = 228\ m\mu$), to produce a neutral K atom, and the latter is bound in a peculiar way in the lattice producing *Farbzentren*. Processes of more immediate interest in the art of photography are next considered in a series of six papers by J. Eggert, F. Weigert, C. F. Goodeve, Dr. Luppo-Cramer and others. It is essentially due to the presence of *"störstellen"* (impurities, irregular spots) in the crystal lattice, that silver bromide exhibits its photosensitiveness. This is particularly so in the region of wavelengths longer than about 500 $m\mu$. In a photo-sensitised process, which is distinguished from a direct photo-process, the essential feature is the transfer of energy from the spot where it is absorbed to one where an emission or a reaction can take place. C. F. Goodeve and J. A. Kitchner have studied the photosensitisation in solids for a number of cases. The term 'exciton' introduced by Frankel to describe the quantum after absorption by an atom, ion, or molecule, is very convenient in considering such transfer of the absorbed energy in solids. In the extreme, the 'exciton' may be a free electron, giving rise to pronounced photo-conductivity.

Equilibria of the type solid (1) $\rightleftarrows$ solid, (2) + gas have been known for a long time but a close study of these reactions has been made only recently, and particularly after the realisation of the essential interfacial character of these reactions. The reactions most closely investigated have been the dissociation of metallic carbonates, and the dehydration of solid hydrates. The formation and growth of interfaces have been studied by W. E. Garner and others. J. Zawadzki describes how various types of spurious equilibria arise in the decomposition of solids, due to sorption, and to the slow rate of crystallisation of the nuclei. The thermal decomposition of certain substances is of an explosive nature, and a study of these explosive detonations has led to the general view that they are initiated by the simultaneous decomposition of a number of neighbouring molecules in the lattice. The rate of propagation of the detonation wave in the crystal is of the order of 4000–7000 metres per second, i.e., the wave travels at about the maximum speed at which thermal vibrations could be transmitted from one ion to another. In an aggregate of explosive material, however, W. Taylor and A. Weale regard that the decomposition follows quite a different mechanism. Here a narrow reaction zone passes through the material with velocities ranging from 1,500 to 10,000 metres per second. A very rapid decomposition takes place in this zone under the action of the impulsive forces in the pressure wave and is primarily due to the grinding together of the granules of the explosive and consequent tribochemical action.

As is well known, solid carbon exists in the three forms, diamond, graphite and amorphous carbon. The reactivity of the two latter phases is extensive and provides very interesting studies. The hexagon layer planes of the graphite crystal lattice behave as molecular entities and have properties closely resembling those of the triaryl methyls. They form layer lattice compounds such as the alkali graphites, and ferrous graphite on the one hand, and graphite monofluoride, and graphite bisulphate on the other, indicating the amphoteric nature of the hexagon layer planes. In these compounds, the hexagon layers persist and the compounds formed are ionic in nature. These reactions are naturally facilitated or hindered by the degree of accessibility of the hexagon layer surfaces. H. L. Riley finds that according to the conditions under which a carbon has been prepared, small amounts of hydrogen or hydrocarbons are present which influence the accessibility of the graphite hexagon layers to the reactant. The finely dispersed active carbons represent a distinct amorphous state according to O. Ruff, and have increased reactivity on account of the large number of lattice faults and consequent large number of free valencies. Activated carbon has found in recent years a number of varied uses. Unlike silica and alumina gels, active carbon is hydrophobic and has, therefore, the advantage that the humidity in gases and vapours which have to be treated does not effect the adsorption capacity considerably. E. Berl has reviewed the formation, properties and specifications of activated carbons.

The last group of papers deal more intimately with the reaction between oxygen and carbon. The strong free valencies on the surface of carbon due to unsaturation at the edges of the graphite crystallites, etc., hold the oxygen atoms by covalent bonds, i.e., by "chemi-sorption". Strickland-Constable puts forth the suggestion that these surface oxides of carbon are definite compounds having a considerable variety of possible structures and atomic constitutions. The kinetics of the simultaneous production of CO and CO_2 during these combustions is explained by L. Meyer and V. Sihvonen through the formation of single keto- and β-diketo groups on the boundary atomic chains of the graphite layer molecules.

There are a number of other interesting papers in this volume, of which an adequate account cannot be given here. The book as a whole is a veritable mine of useful data and informations. It is priced at 12/- with paper covers.

M. A. Govinda Rau.

Agriculture and Animal Husbandry in India

THE report of progress in agriculture and animal husbandry in India during the year 1936–37, issued under the authority of the Imperial Council of Agricultural Research, affords as usual a comprehensive summary of agricultural development in all its aspects and forms, like its predecessors, a very useful book of reference to all those interested in the agriculture of this great country. Progress has been so many-sided and scientific activities so numerous that it is no easy task to make a connected and comprehensive narrative of all of them in their due perspective, but the Council has succeeded very well in the attempt. The report, however, relates to work which is now nearly two years old, and though the delay is somewhat unavoidable, one wishes that some arrangement may be made by which future reports can be published without such a long interval elapsing. The information is grouped and dealt with along the same lines as in former reports, with the exception that more attention is devoted to "Fruit development" and "Fodder crops and grazing", which are each given a special chapter.

Considerably more money was made available for agricultural research and development during the year; the total gross expenditure for the whole country rose by Rs. 18 lakhs for agriculture and by Rs. 5 lakhs for veterinary science. The Central Government also made a special grant of the large sum of Rs. 2·82 crores for rural development out of which agriculture has had its due share. The year was notable for the visit of Sir John Russell and Dr. N. C. Wright to India to examine and report on the work carried on by the Imperial Council of Agricultural Research. The recommendations contained in their reports which are of a far-reaching character, are summarised in this report, but the action taken or proposed to be taken in respect of these recommendations which are really what would interest one more, do not come within the purview of this report. As regards the adoption of improvements by cultivators, notable progress has been reported in the cultivation of improved varieties of the various crops; the area under such varieties rose from 21·4 million acres in 1935–36 to 23·9 million acres in 1936–37, though this by no means represents the whole extent of such increase. Extensive and well-organised schemes of seed distribution following on crop improvement work by all the departments, central and provincial, continued to make steady progress. Similar progress is reported in respect of fertilisers; the import of chemical fertilisers rose from 72,210 tons to 83,653 tons in the year. Though the consumption of sulphate of ammonia rose from 57,164 tons to 76,360 tons, the share of local production was only 17,748 tons. Local production indeed recorded a slight fall from 17,851 tons to 17,748 tons. One would wish to see the day when India's requirements of phosphatic and nitrogenous fertilisers at least will be fully met from Indian production. In respect of improved implements progress has been moderate, but the redeeming feature is that they are of Indian manufacture, a development which is showing encouraging signs of expansion. Progress in well-boring operations and the installations of pumping sets for irrigation makes interesting reading, both in the variety of operations and in the success that has attended them. In respect of crops aside from the various manurial, cultural and crop improvement investigations, those relating to "quality" deserve special mention and results of considerable practical value are already reported in respect of one, *viz.*, rice. This line of work is eminently worthy of expansion so as to embrace other crops as well and more of their "quality" characters. Questions relating to fodder and grazing were the subjects of discussion at three conferences in the year at which forest grazing, improvement of grasslands, better utilisation of waste lands and kindred matters were gone into and a recommendation made for the establishment of a central and provincial fodder and grazing committees for paying special attention to these matters. Under "Fruit development" the results of work on cold storage being conducted in Poona are notable, their practical application in the fruit trade of the country will no doubt soon follow. Progress is reported in many fields of animal husbandry especially in respect of the supply of breeding bulls. A compilation of the type characters of certain important breeds of cattle and buffaloes was arranged for in the year. Many of the numerous investigations under crops, pests and diseases, dairying and cattle improvement were in varying stages of progress and many of them are referred to in broad outline. Forty schemes were completed and there were as many as 136 schemes in the course of investigation at the end of March 1937—a fact which shows that after all agricultural research is not altogether neglected in India. The chapters on agricultural education, veterinary education, District-work and agricultural co-operation give relevant information for the year under report and a number of appendices furnish much statistical details.

A. K. Y.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(Madras University Library, and Secretary, Madras Library Association)

Hollings, John (1683–1739)

JOHN HOLLINGS, a British physician, was born at Shrewsbury in 1683. His father was an M.D. Having attended the local grammar school, he joined the Magdalene College, Cambridge, in 1700 and became a Fellow of the Royal College of Physicians and of the Royal Society in 1726. He eventually became Physician-General to the Army.

Hollings was reputed to be a man of considerable culture and scholarship. His only book entitled *Status humanee naturæ expositus in oretione corum medicis Londinensilus habita* was his Harveian oration of 1734.

Hollings died May 10, 1739.

Davies, Thomas (1792–1839)

THOMAS DAVIES, another British physician, was born in Carnarthenshire in 1792. He was apprenticed to his maternal uncle who was apothecary to the London Hospital. While practising independently a few years later, he had symptoms of pthisis which made him go abroad. He prosecuted his medical studies in Paris and learnt the new art of ausculation from its inventor, Laennec. Having got his M.D. degree in 1821, he returned to London where he set up private practice and disseminated what he had learned from Laennec by delivering courses of lectures at his house. This brought him some recognition and led to his appointment as lecturer at the London Hospital.

His lectures on the diseases of the lungs and heart were first published in the *London medical gazette* and later as a book. This book gave a faithful exposition of the discoveries of Laennec.

Davies died of chest disease May 30, 1839.

Graham, John (1805–1839)

JOHN GRAHAM, an amateur British botanist of India, was born in Dumfriesshire in 1805. He came to India in 1826 and was soon appointed Deputy Postmaster-General of Bombay.

He was also put in charge of the Botanical Gardens of Bombay. In this capacity, he enriched the collections of that Garden to a considerable extent. He began a catalouge of Bombay plants which was completed and published posthumously by J. Ninmo, as Graham died suddenly at Khendalla May 28, 1839.

Cooper, Thomas (1759–1839)

THOMAS COOPER, a British scientist of America, was born in Westminster, October 22, 1759. He was educated in classics while at Oxford. But later, while his father intended him for Law, he took a clinical course in the Middlesex Hospital and established practice at Manchester. He later practised as a lawyer. However, his scientific attainment warranted his nomination to the Royal Society by his friend, Joseph Priestley.

After involving himself in political matters for sometime, he got disgusted with the practical working of democracy and migrated to America. There he became a friend of Jefferson and after active political life for some years, he was elected to the chair of Chemistry in Carlisle and later in the University of Pennsylvania. In 1820 he changed over to South Carolina College. He was a prime factor in the establishment of the first school of medicine and the first lunatic asylum in the State.

The influence of Cooper on his generation was mainly through his versatile and prolific pen. He wrote much on law and political science. His *Lectures on the elements of political economy* (1826) was the first of its kind. His *Institutes of Justinian* (1812) and *Statutes at large of South Carolina* are monuments of his legal learning.

His scientific writings were also equally important and voluminous. He edited the *Emporium of arts and sciences*, published treatises on a variety of subjects like dyeing, calico-printing, gas lights, and edited several European text-books in chemistry. His description of the scientific discoveries of his friend Priestley (1806), his *Introductory lecture on chemistry* (1812) and his *Discoveries on the connection between chemistry and medicine* (1818) were justly famous and far ahead of the ordinary state of knowledge of his times.

Cooper died May 11, 1839.

ASTRONOMICAL NOTES

Planets during June 1939.—Mercury will be in superior conjunction with the Sun on June 7 and will be visible as an evening star about the end of the month. Venus can still be seen as a fairly bright object near the eastern horizon for about an hour and a half before sunrise. It continues to get closer to the Sun and is becoming fainter. On June 17 there will be a close conjunction of the planet with the Moon. Mars reaches the meridian at about 3 a.m. and is well placed for observation during the latter part of the night. On June 24, it will be at one of the stationary points of its apparent orbit. The planet is increasing considerably in brightness, the stellar magnitude being −2·0 at the end of the month.

The major planets Jupiter and Saturn continue to be visible as morning stars; the former rises about an hour after midnight and can be seen as a bright object (mag. −2·0) in the early hours of the morning. The ring ellipse of Saturn is gradually getting wider, the angular dimensions of the major and minor axes being 38″·0 and 10″·0 respectively, about the middle of the month. Uranus is also a morning star and will be situated about 2° to the south of the star δ Arietis (mag. 4·5). A close conjunction with the moon will occur on June 15 and will be helpful to observers in locating the planet.

Comets.—Pons-Winnecke's Comet is visible as a faint object (of magnitude 13 on May 10) and is moving slowly in the constellation Bootes. Information has been received of the discovery of a bright Comet (1939 d) on April 18 by Hassel at the Oslo Observatory. At the time of discovery the Comet was of the third magnitude and is reported to have had a nucleus and a short tail.

It has become fainter since then and has been moving rapidly in a south-easterly direction in the constellations Perseus and Taurus. An orbit computed by Möller gives 1939 April 10 as the date of perehelion passage.

Kopff's periodic comet was re-discovered on April 22 by Prof. Van Biesbroeck at the Yerkes Observatory. It appears to have been a faint and diffuse object without central condensation or nucleus.

T. P. B.

SCIENCE NOTES AND NEWS

The Drainage of India.—Dr. S. L. Hora has made an important contribution (*Proc. Nat. Inst. Sci. India*, 1938, 4, No. 4) on "Changes in the Drainage of India as evidenced by the Distribution of the Freshwater Fishes". Dr. Hora has, by this and other publications, pointed out the zoogeographical importance of the Indian fish fauna and thus made the study of Ichthyology more interesting. It has been clearly shown that the distribution of both past and present-day freshwater fishes constitute an important criterion for the elucidation of the palæohydrographical features of land masses. A brief geological history of India is given. A main drainage of the Upper Gondwana period has been indicated by the presence of the Dipnoan and the Ganoid fishes in the Kota-Maleri beds in the Godavari valley. Based on the occurrence of the estuarine fishes in infra- and inter-trappean beds of the Central Provinces, it is concluded that during pre-trappean period a main river flowed towards Rajputana. Further it is pointed out that during the post-trappean period the drainage of the Peninsular India was reversed. That the modern bony fishes particularly the Siluroids had become dominant as early as the Siwalik period is evidenced by their remains among the Siwalik rocks. Based on the distribution of fishes Dr. Hora supports the view of the existence of 'Indobram' or 'Siwalik' river.

Further Dr. Hora contends that freshwater fishes originated in Southern China and from thence spread to all directions. A close similarity between the fish fauna of the Peninsular India, Eastern Himalayas, Burma, S. China and Malay regions is shown. The occurrence of forms like *Bhavania* and *Silurus* in the hill streams of the Western Ghats indicates that they must have migrated from the Assam hills *via* the Satpuras by a series of river captures. The publication of Dr. Hora's article on the fish remains of the Central Provinces, to which reference has been made in this paper, is keenly awaited.

* * *

The Indo-Brahm or the Siwalik River.—At the ordinary monthly meeting of the Royal Asiatic Society of Bengal, held on Monday, 1st May 1939, Dr. Baini Prashad presented a paper on the Siwalik River, the occurrence of which during the Tertiaries was postulated in 1920 by Sir Edwin Pascoe of the Geological Survey of India, as a result of his study of the Punjab Oil Belt. The headwaters of the river corresponded with those of the Brahmaputra. "Through Assam the river flowed westwards and north-westwards along the foot of the Himalayas as far as North-West Punjab, and then turning southwards along a course, not very different from that of the modern Indus, it emptied itself into the Arabian Sea. Almost simultaneously Dr. G. E. Pilgrim of the Geological Survey, from a study of the Siwalik Conglomerates, communicated a paper to the *Asiatic Society*, in which he suggested that there was a single westwardly flowing river, the Siwalik River, in place of the Indus, the Ganges and the Brahmaputra River systems, which served for the drainage both of the eastern and western Himalayas. Both the authors did not refer to the earlier communications by

Oldham (1894) and Kobelt (1899) in which similar views had been put forward." Dr. Baini Prashad discussed the zoological evidence in support of the existence of such a river system.

* * *

Indian Museum Fish Gallery.—One of the interesting additions to the newly arranged fish gallery is the Air-breathing fish of India. Of these one is the well-known Koi fish of Bengal (*Anabas*) which possesses two special chambers developed above the gills for the storage of air, each chamber acting as the 'lung' of the fish. Other types exhibited are the snake-headed fish, *Sol, Sauli, Lata*, etc. (*Ophicophalus*), *Magur* (*Clarias*), *Singi* (*Heteropneustes*), and *Cuchia* (*Amphipnous*). The various structures responsible for aerial respiration are shown by dissected models.

The need for using atmospheric air directly seems to have been necessitated by occasional droughts of varying duration which impelled the fish to live in stagnant waters deficient in oxygen. It was in response to such circumstances that a number of fish came to the surface to make use of the vastly greater quantities of oxygen in the air. The kinds of devices employed by the fish for using atmospheric air are so varied that it seems probable that this habit was independently acquired by a number of them.

To create interest in the food fish of India the *Zoological Survey of India* has put up a special exhibit of the principal food fish of the Calcutta markets in the Fish Gallery of the Indian Museum. Actual stuffed specimens or models of as many as 28 varieties of fishes are shown.

Attention is directed to the fact that the available supply in the Calcutta markets is far from sufficient and only a small percentage of the total quantity offered for sale in the Calcutta markets is from local fisheries. Most of the freshwater fish are imported from Southern and Eastern Bengal and the Chilka Lake, the estuarine fishes come from various parts of the Gangetic Delta, while the marine forms are imported from Puri and other sea-ports.

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Prince of Wales Museum of Western India, Bombay.—The Report for the year 1937–38 recently issued, gives a brief outline of the activities of the Museum. A new wing (opened by H. E. Sir Roger Lumley, G.C.I.E., D.L., Governor of Bombay, on March 17th) was added during the year, at a cost of Rs. 2½ lakhs. On the ground floor of this wing, are displayed the collections of the Natural History Section in attractive settings in a manner which reflects a striking improvement in museum exhibition in India. At the same time, the attractiveness and educational value of the exhibits have been greatly enhanced.

The Report draws attention to several interesting investigations conducted by the staff. Mention may be made of the Man-eating Hyænas from the United Provinces. The Curator's investigations show that the common Hyæna may resort to man-eating when pressed by hunger due to shortage of natural food. Once established in an individual, man-eating may become a tradition passed on from mother to offspring, and attacks on human beings may recur until the particular stock that has acquired this trait is exterminated.

Among the Acquisitions to the Natural History Section, mention may be made of a fine specimen of Bewick's Swan (*Cygnus bewickii*) presented by E. S. Lewis, Rajpore, Delhi. A breeding colony of the little Tern (*Sterna albifrons albifrons*) was discovered by Mr. Humayun Abdul Ali in a small island near Bombay. Messrs. Ali and McCann have obtained fine specimens of the birds and eggs.

It would be impossible to mention the several activities of the three sections of the Museum, the Arts section, the Archæological section and the Natural History section, in this note. The number of visitors to the Museum has averaged over 21,000 a day, when open to the public free of charge. After the new wing was opened, the number has appreciably increased. The Report points out that the new wing provides only for public galleries; there is, however, pressing need for providing accommodation for research collections, library, office, work rooms and lecture hall, and it is hoped that generous-minded wealthy citizens of the Presidency and the Government will come forward to provide necessary funds to enable these additions, so essential for the Museum, to be made.

* * *

Madras Fisheries Department.—To an impoverished country like India, whose large tracts suffer from frequent visitations of famine and whose populations are afflicted from malnutrition, it is a matter of paramount importance that the food resources of the sea should be explored and harvested. The importance of developing fisheries in India has been frequently emphasised in the columns of *Current Science*.

The administration report of the Madras Fisheries Department for the year 1937–38, which has been recently published, reveals the various lines of useful work carried out by the department. Of particular interest are the technological researches relating to deep sea fishing methods, fish manures, prawn pickling, and the vitamin survey of fish oils. Some of the oils particularly from certain kinds of shark, have been found to be exceptionally rich in their vitamin content. It is to be hoped that these encouraging results will be soon commercially exploited.

* * *

Haffkine Institute.—In addition to the routine production of large quantities of prophylactic vaccines, the Haffkine Institute is establishing itself as a producer of new knowledge under the direction of Col. S. S. Sokhey. The Annual Report for the year 1937, which has been recently issued, records several lines of investigation which are being persued at the Institute. Researches relating to the several aspects of plague and its vaccine by Col. Sokhey and his collaborators, Pharmacological studies of antimalarials by Dikshit and his collaborators, researches relating to certain diagnostic constants of blood, investigations on snake venoms, and a study of the cultural requirements of the plague bacillus, constitute some of the useful

lines of investigation which have yielded promising results. It should be a matter for satisfaction to the Director that the Institute has not only attracted a number of voluntary workers but also secured generous support from the Indian Research Fund Association for most of the above researches.

* * *

Quality of Digitalis Preparation sold in India.—A representative survey of the digitalis preparations sold in India carried out by the *Biochemical Standardization Laboratory*, Calcutta, has led to the finding that a large proportion of the preparations is below par. Digitalis preparations are extensively employed by Physicians in the treatment of heart diseases. The Laboratory collected some 110 samples (102 tinctures and 8 powders) from all provinces of British India and analysed them by the 'Intravenous Cat Method' recommended by the British Pharmacopœia. As many as 87 preparations were below 80 per cent. in strength and 57 were below 50 per cent. potency. 102 samples in the group were of Indian origin and 8 of foreign make. It is suggested that all digitalis preparations issued for sale should be tested and their potency controlled before they are released into the market. Strict precaution should be enjoined regarding their storage in cool and dark places, preferably in cold storage and all digitalis tinctures more than a year old should be retested for their potency and if below par, withdrawn from clinical use.

* * *

Survey of India.—Full details of the Survey Operations of the ordinary field units, as well as, of map publications and instrument manufacture for the year 1938, are now compiled from the General Report of the Survey of India recently issued. The report also gives an abstract of the other volume "The Geodetic Report" containing full details of all scientific work.

The earliest maps of India prepared by Major James Rennel, the first Surveyor-General of Bengal in 1767, were originally military reconnaissances and latterly chained surveys based on astronomically fixed points and from these beginnings, this department has gradually become primarily responsible for all topographical surveys, explorations and the maintenance of geographical maps of the greater part of Southern Asia and also for geodetic work.

During the year under report, the area surveyed was 38,559 square miles. The report gives an abstract of the geodetic operations including the measurement of geodetic bases, principal triangulation, geodetic levelling, precise latitudes, longitudes, azimuths, seismological and meteorological, gravity determinations in all parts of India and predictions of tides at 41 eastern ports between Suez and Singapore. The longitude of Dehra Dûn has been determined by the bi-weekly transit observations; latitude observations at Agra show surprisingly large variation as was also found at Dehra Dûn.

The re-adjustment of the primary and secondary triangulation has been completed so far as it is at present contemplated to take it, until circumstances make it possible to adopt the International Spheroid instead of Everest's which is unlikely to happen for many years to come.

The probable errors of the primary and secondary triangulation have been investigated and it is found that the length and breadth of India have been measured with probable errors of about 1 part in 500,000 or of 20 feet in 2,000 miles.

Investigations have been made regarding the anomalies of magnetic force associated with underground bodies of magnetic rock. At 48 stations in Bengal, S.W. Baluchistan, the Punjab and Rajputana, observations to determine the force of the gravity were made. In co-operation with the Geological Survey and the Burmah Oil Company the effect of known geological abnormalities on intensity of gravity is being studied.

Observations for latitude and longitude were made at 49 stations along a line running southwards from near Mandalay to near Victoria Point and these observations confirm the existence of a very large southerly rise of the geoid in this area.

The old triangles of the Assam Longitudinal Series between Gauhâti and Goâlpâra were reobserved.

An abstract of topographical work is given in Part 3 of the Report. The tables A, B and C indicate the progress in the topographical survey programme and contain details of the work done during the year. Table A indicates the area of survey completed since 1905 as well as what remains over to complete the contoured Topographical Survey of India, Table B shows the area revised during the year and Table C ennumerates in detail the survey operations carried out during the year under report.

The Survey of India, from the year 1905, concentrated on the preparation of a new series of modern topographical maps in several colours on the 1 inch to 1 mile scale; this new series is meant to meet the demand for more detailed information to be shown on maps, especially as regards the portrayal of hill features by contours, proper classifications of communications and more recently of air traffic requirements. This series intended to be completed in twenty-five years, is only two-thirds completed by 1938, full progress having been deterred by the outbreak of the War and other circumstances. Though every year, thirty to sixty thousand square miles of area are surveyed, the maps of a large part of the country are still over fifty years old.

Air survey work for civil purposes is also receiving a good measure of attention and continuous research is being carried on, in the latest methods of mapping from photographs taken from the ground and in the air. Photographic methods have been employed for the survey of about 1,600 square miles of area. An air survey of Bettiah Town has also been undertaken.

The last part of the report details the progress of map publication to date. Progress of publication to date, of a standard series of modern maps, excluding transfrontier work is indicated in Index maps C to G at the end of the report. All publications and map issues for the year, the fair drawing carried out by the

various drawing offices and field parties and the working of the printing and miscellaneous offices are indicated in this part of the volume.

The Mathematical Instrument Office has continued to do increasingly useful work, the manufactures and repairs covering a wide range of scientific instruments. During the year there has been a considerable increase in the value of stores issued and in the output of the work.

C. G.

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Mustard and Rape Seed Industry in India.—A recent publication issued by the Indian Industrial Research Bureau (A Study of Indian Mustard and Rape Seed and their Oils, *Bulletin* No. 13, Manager of Publications, Delhi, 1938. Price 14 annas) draws attention to the present mustard and rape seed industry in India. Technical data on which an All-India Standard Specification for mustard oil may be based, are presented and it has been shown that mustard oil of equal pungency and of superior yield to that given by the indigenous *ghannis*, can be obtained from modern plant when suitably operated.

The possibility of identifying seeds of different Brassica species by the microscope examinations of their seed-coat structures, has been indicated and the factors controlling pungency and the improved milling methods for the extraction of oil are discussed.

Since there is a strong tendency to adulterate this oil, difinite specifications have been fixed by the different Provinces. These values have been compared with those of the oil extracted from the pure seeds, and it is concluded that certain mustard oil specifications in force in India need modifications to admit genuine oils. Certain specifications are also recommended.

In the last chapter the authors deal with pungency and the oil mill technique, "pungency in edible mustard oil", they conclude, "depends on hydrolysis of the glucoside present in the seed, and the optimum temperature for the reaction is between 40°-45° C.". They have also shown "that if mustard seed is pressed in a *ghanni* or in any other type of machinery without being moistened, or if the seed is heated about 70° C., the oil obtained lacks the essential mustard smell". It was found that the modern oil milling plant can be used to produce pungent oil, if operated according to the improved methods described in the *Bulletin*.

The publication will prove useful to the Oil Mill owners who wish to utilize their modern plant in extracting pungent mustard oil of commerce. To the plant breeder and botanist the knowledge of the seed-coat structure of different *Brassica* species and *Eruca sativa* illustrated by photographs will be of immence value.

R. H. R.

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The Imperial Bureau of Plant Breeding and Genetics, Cambridge, has recently issued a bulletin on "The Action and Use of Colchicine in the Production of Polyploid Plants" (by J. L. Fyfe, Price 1*sh.*). The discovery of the action of the drug colchicine on nuclear division, making it the most reliable agent yet used in the production of polyploid plants, has excited great interest even in laymen and is of importance to those working on the cytology or genetics of plants. The bulletin begins by explaining the chromosome doubling; next a detailed account of the action of colchicine on mitosis and meiosis is given, followed by summaries of the results obtained from the use of colchicine for producing polyploid plants. The action and use of acenaphthene, which the Russian workers have shown to be a similar agent to colchicine, are also described. Particular attention has been paid throughout to treatments and dosages and some recommendations are given which should be helpful to those contemplating the production of polyploids. All the literature appearing up to the end of January 1939, is included and listed in a bibliography of 38 references.

* * *

Guiding Principles for Studies on the Nutrition of Populations.—The Health Organisation of the **League of Nations** has just published a handbook entitled *Guiding Principles for Studies on the Nutrition of Populations* by Professor E. J. Bigwood, of Brussels University. (Ser. L.o.N.P., 1939, III, I, 281 pages. Price 6/-, $1·50.)

The author has endeavoured to work out methods of enquiry which can be generally applied as to the actual food consumption and the state of nutrition of given population groups. The handbook is divided into two parts: (A) *Dietary Surveys*: There are four types of dietary survey: investigations may extend over a whole country, or be limited to population groups, to families, or to individuals.

The author describes the technique of these surveys—weighing methods; method of records in household books—questionnaire method, etc.; he then deals with the analysis of the collected data from the standpoint of the physiology of nutrition and with the scales of family consumption coefficients which have to be used in comparing the results of enquiries concerned with groups of different age and sex composition. The last two chapters of Part I deal with diets from the economic standpoint and the statistical significance to be assigned to the results of surveys. (B) *Enquiries into the State of Nutrition of Populations*: In this part of his handbook, the author discusses the somatometric (biometric, clinical and physiological) methods that may be suitably employed in these investigations. Special attention is given to the physiological methods, especially those for detecting latent hypovitaminoses and iron deficiency.

The handbook is completed by examples of surveys of various types in a number of different countries; it also comprises a terminological index and bibliographical references.

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The Child Welfare Information Centre of the League of Nations has just issued *The Summary of the Legislative and Administrative Series of Documents of the Child Welfare Information Centre* unblished in 1938 (*Ser. L.o.N.P.*, 1939, Vol. 1, pp. 58. Price 1*sh.*)

"A glance at this publication shows what questions have been engaging the particular

attention of Governments in the last few years. It will be seen, for example, that the protection of neglected and delinquent children has made fresh progress in nine countries, and that the small number of countries which inflict corporal punishment on minors has been further diminished, since New Zeland has amended her legislation so as to abolish whipping inflicted by order of the Children's Courts.

"In another direction it will be observed that the United Kingdom has made a bold innovation in the legislative sphere by investing the local authorities of the large towns with the power to close certain streets for traffic at certain hours in order that they may be utilised as playgrounds. The effects of this measure will be felt both as regards the prevention of juvenile delinquency and that of the protection of children against the physical dangers of the streets.

"A number of countries make no distinction between the protection of children and the protection of families. In this connection the Uruguayan law of April 19, 1938, authorising the constitution of "homesteads" and laying down the conditions attaching thereto is a document of great interest."

* * *

Naturalistic Measures in the Control of Malaria.—The latest issue of the *Bulletin of the Health Organization* of the League of Nations (No. 6) is mainly devoted to rural life problems. Drs. Heckett, P. F. Russell, J. W. Schraff and Senor White have discussed in an interesting article, the present use of naturalistic measures in the control of malaria. "In including this problem, the Malaria Commission of the League of Nations had in mind the questions raised by rural malaria in poor countries. The article deals with the first step towards the solution of the problem by critically surveying all action taken so far on naturalistic lines. This is defined as "the deliberate extension or intensification of natural processes which tend to limit the production of mosquitoes or their contact with man". The authors stress the desirability of creating experimental centres and of ascertaining the cost of methods before applying them".

* * *

A study of the Jute apion has been undertaken at Dacca in the Agricultural Research Laboratory of the **Indian Central Jute Committee**. A survey of the low land areas in the Rangpur District revealed that young seedlings were attacked by a number of pests and diseases. The jute apion does not appear to have been previously recorded at such an early stage. To study their life-history, the jute apion and the indigo-caterpillar are being reared in the Laboratory. From the diseased material, species of Rhizoctonia, Fusarium and Alternaria have been obtained.

* * *

The creation of a separate government department in order to undertake research on earthquakes is urged in the Memoir on the Bihar-Nepal Earthquake of 1934, just issued by the Geological Survey of India. The subject is too specialised to be regarded as requiring the occasional attention of the meteorological department and the Geological Survey. The work could be more thoroughly and authoritatively studied by whole-time specialists. There are two lines of investigation awaiting such a department: (a) the prediction of future earthquakes as to time and place, and (b) the means of minimising their effects. "From a scientific and engineering view-point, the whole of North India within, say, 200 miles of the foothills of the Himalaya, must be regarded as a region particularly susceptible to severe earthquakes". Evidence exists for postulating the constant movement of the Himalaya throughout tertiary times down to the present day, a movement directed laterally towards the peninsula and giving rise to great horizontal thrust planes. On the Peninsula in Chota Nagpur, there has been a succession of upward movements during Tertiary times, giving rise to a general tilting towards the north. In the Gangetic Plains between, there has been constant subsidence. It is believed that all these movements are related. In the downward folded zone of the Gangetic Plains between the two uplifted regions of the Himalaya and the Peninsula, a state of strain or potential fracture is presumed to exist.

* * *

We understand that the Locust Research Scheme of the Imperial Council of Agricultural Research, which has till now been located at Karachi under the Locust Research Entmologist, has now been difinitely closed. In view, however, of the importance of continuing the work of watching the deserts in the Indian area for locust developments and of warning the Indian cultivator about locust invasions in advance, the Government of India have sanctioned, with effect from 1st April 1939, the establishment of a "Locust Warning Organisation" under the supervision of the Imperial Agricultural Research Institute, New Delhi, for which the services of a good part of the staff of the late Locust Research Scheme have been retained. The desert staff is to be controlled by a Superintendent stationed at Karachi.

* * *

The Twenty-first Anniversary of the **Bose Institute** was also the first Memorial Meeting for its illustrious Founder, Sir Jagdis Chandra Bose, who dedicated this Institute to the Nation on his fifty-ninth birthday, November 30, 1917. Sir Nilaratan Sirkar, in his Presidential Address, gives a very interesting summary of Bose's life and work, and points out that the Bose Institute is the "first and foremost among his gifts for the advancement and diffusion of knowledge. ..... This unique Institution, with its potentialities, should form an invaluable asset to the Nation, provided we knew how to utilise it." Sir Nilratan concludes with a quotation from Bose's inaugural address delivered on the Foundation Day of the Institute, a masterpiece of Bose's poetic imagination, literary skill and dynamic philosophy.

Dr. D. M. Bose, the present Director of the Institute, gives an outline of the work now being carried on at the Institute in plant physiology, plant genetics, agriculture, biochemistry, zoology, anthropology, and the chemical analysis of soil, food-stuffs, and the active constituents of Indian medicinal plants. The Physics

Laboratory of the Bose Institute has been enlarged for investigations in spectroscopy, ultrasonics, natural and artificial radioactivity and cosmic radiation. In co-operation with the Departments of Physics and Applied Mathematics of the University College of Science, Calcutta, the Institute conducts a lively Colloquium on Nuclear Physics.

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Mr. P. M. Kharegat, C.I.E., I.C.S., lately Secretary, Industries and Education Department, United Provinces, has succeeded Sir Bryce Burt, C.I.E., M.B.E., I.A.S., as Vice-Chairman, Imperial Council of Agricultural Research.

* * *

The Maynard-Gangaram Prize for the year 1939 has been awarded to Rao Sahib Ch. Ram Dhan Singh, M.A. (Cantab.), Cerealist, Punjab Agricultural College, Lyallpur, in consideration of his meritorious work on the breeding of new wheat varieties.

* * *

Cawnpore Sugar Technology Institute.—The annual report of the Imperial Council of Agricultural Research for the year 1937–38 gives details of the training facilities provided by the Cawnpore Sugar Technology Institute. It will be remembered that the Institute was established by the Government of India in October 1936, on the recommendations of the Tariff Board and the Sugar Committee, for a period of five years. It undertakes research on (1) Problems of Sugar Technology in general and those of sugar factories in India in particular; (2) Utilisation of bye-products of the industry; (3) Detailed testing of new varieties of cane under factory conditions; and (4) General problems of sugar engineering and chemistry.

To meet the demand for specialised technical staff for work in sugar factories, the Institute trains students in all branches of Sugar Technology and Sugar Engineering and arranges for refresher courses for men already employed in industry. In Sugar Technology and Sugar Engineering, a three years' course for the diploma of I.I.S.T. is provided. Graduates in Physics, Chemistry and Mathematics, Mechanical or Electrical Engineering are eligible for admission. Twelve admissions are made each year.

The Sugar Boilers' Certificate course is open to candidates who have passed the Intermediate Examination in Science or any equivalent examination. It is a one-year course; after two years, experience in Pan-boiling, the student becomes entitled to the certificate. Twelve admissions are made each year.

Three admissions are made yearly for post-graduate research in the sugar technology section and three in the sugar engineering section. The course extends to two years during the non-working period of cane factories and two seasons' factory experience after qualifying for the associateship. The diploma of F.I.I.S.T. is the highest Government diploma of Sugar Technology or Sugar Engineering in India.

Arrangements have also been made for short courses on a variety of subjects relating to Sugar Industry for candidates who do not possess the necessary technical and academic qualifications for the higher courses. These include a two sessions' course on Chemical Control and Bacteriology and a one session course on Pan-boiling, Fuel and Boiler control, Statistics (for sugar students), statistical methods (for research students) and training in Dutch and German languages. The sessions are usually held during the sugar off-season, so that actual employees in sugar factories may not be at a disadvantage. The general qualifications required for short courses are a B.Sc. degree with Chemistry, and some practical experience in a sugar factory. A high school leaving certificate is the minimum qualification for a Pan-boiling course, for the course on Statistics (for sugar students), the candidate is required to have passed the I.A. or I.Sc. with Mathematics as one of the subjects.

The Institute grants two scholarships of Rs. 25 per month each, one for the Associateship Course in Sugar Technology and the other for the Associateship Course in Sugar Engineering.

An employment bureau assists the ex-students of the Institute in finding jobs in Sugar Factories.

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University of Mysore.—I. *Lectures*: Under the Scheme of Extension Lectures, Mr. V. L. D'Souza, B.A., B.com., delivered a lecture in English on "Population and Production" at each of the places, Shimoga and Bhadravati.

II. *Meeting of the Senate*: The annual meeting of the Senate was held on the 31st March 1939. Among the propositions that were passed, mention may be made of the following:—(1) Holding the Final Examination for the M.B.B.S Degree twice a year; (2) Removal of the condition of a pass in the Intermediate examination in the case of candidates who hold the L.M.P. Diploma of Mysore and who seek admission to the Pre-Medical Course; (3) Holding the University examinations in future in February and March instead of March and April commencing from 1940, the University session commencing on 1st June instead of on the 24th; (4) Recommendation to the University Council to take necessary steps for affording the University students every opportunity for obtaining Military Training on suitable lines; (5) Recommendation to the University Council for the deputation of two members of the University staff in the cadre of Assistant Professor of English to England for higher studies in English Language and Literature; (6) Recommendation to the University Council for taking all necessary steps for establishing an Intermediate College at a mofussil centre to be selected by the Council; (7) Opening of a 'University Adult Literacy Campaign' in connection with Rural Reconstruction Centre now located by Government at Closepet.

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Enquiry into the Cultivation of Cloves in India.—The subject of this enquiry, *viz.*, cloves, is one of those important agricultural products of commerce about which little is known. It was a welcome attempt on the part of the Imperial Council therefore to have instituted the present survey which not only brings out the very gratifying fact that cloves are already growing in the country and that the conditions of soil and climate in certain parts are quite suitable for its cultivation but also brings

together a comprehensive mass of information bearing on all aspects of the cultivation methods as carried out both in this country and in the more important centres of cultivation outside such as Zanzibar, Madagascar, Ceylon, and the Dutch East Indies (Report of an Enquiry into the Cultivation of Cloves in India by A. K. Yegna Narayan Aiyer, *Misc. Bulletin*, No. 20, Manager of Publications, New Delhi, 1938). An interesting account is given of the great attempts of the old East India Company to introduce the cultivation into India from the Dutch East Indies and thereby break the monopoly which the Dutch enjoyed in respect of this costly and valuable product, in those far off days of the struggle for supremacy in the trade with India and the orient generally. A description is given of the clove groves to be found in India, and for the sake of comparison of the clove groves in Ceylon, the descriptions being illustrated by photographs. The present trade in cloves in India is reviewed, there being an import annually of some 62,000 cwts. valued at about forty lakhs of rupees, though in a peak year the imports rose to over 73,000 cwts. This gives an idea of the scope there exists for local production. The soils of the present clove areas in India and those of the Ceylon areas for comparison have been analysed and these elaborate data form an important feature of the survey. Nursery practices, varietal characteristics, manuring, pests and diseases, harvesting and curing methods are dealt with in detail. With the exception of the fact that at the young stage the plants are delicate and are difficult of establishing, the cultivation appears to present no difficulties. Experimental cultivation on an area of about one hundred acres in the different cligible centres is suggested, as well as a study of various methods of propagation for overcoming the initial difficulties and securing other advantages. It is now up to the Imperial Council to follow up this commendable beginning with definite practical steps for the starting of the cultivation in the centres spoken of as suitable in the Report.

* * *

The Composition and Agricultural Value of the Fine Ejecta of Volcanic Eruptions.—The eruption of the Mayon Volcano in the Philippine Islands in the month of June 1938 was taken advantage of to determine the chemical and physical composition of the ejecta and its agricultural value by N. L. Galvez (*The Philippine Agriculturist*, 27. Nos. 9 & 10). Seven samples were examined, six of which were similar in texture to ordinary soils, while the seventh belonged to that class of ejecta called lava. The chemical composition of the latter was found to be almost identical with the former, which analysed as follows:—SiO_2 56·36, TiO_2 0·78, Al_2O_3 19·37, Fe_2O_3 8·23, MnO 0·4, CaO 8·50, MgO 1·13, K_2O 1·16, SO_3 0·40, P_2O_5 0·56 and loss on ignition 0·72. The lava differed materially from the other ejecta only in the loss on ignition and the Fe_2O_3 contents which were 0·20 and 7·80 respectively. Analysed for their agricultural value, the six samples contained on the average (in the portion soluble in 10 per cent. HCl) among other constituents the following:—Al_2O_3 4·67, Fe_2O_3 1·53, CaO 2·17, MgO 0·20, K_2O 0·07, Na_2O 0·57, P_2O_5 0·10. One of the samples contained a trace of nitrogen while the others, including the lava, contained nothing of this constituent. The insoluble residue was high, *viz.*, 88·76. The amount of available K_2O was low while that of available P_2O_5 higher than for ordinary soils. The fine ejecta is hygroscopic and acidic in reaction and the leaves of abaca (*Musa textilis* Nee) and papaya (*Carica papaya* Linn.) on which the ejecta settled became scorched and wilted, in consequence. Though the samples were all devoid of any nitrogen, they contained (collected two weeks after the eruption) colonies of bacterial growths of moulds and sulphur-oxidising organisms, while nitrifying and azotobacter organisms were absent. A. K. Y.

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Announcements

Seventh World's Poultry Congress and Exposition.—The Seventh World's Poultry Congress and Exposition will be held at Cleveland, Ohio (U.S.A.), from July 28 to Agust 7, 1939. Immediately before and after the Congress, a series of tours to various parts of the country will be arranged for visitors. It is the desire of the General Congress Committee that National Committees be formed as soon as possible by all countries expecting to participate in the Congress. Each National Committee will serve to organize the representation of its country at the Congress and to maintain contact with the United States Organization.

The following five sections will comprise the Scientific Sessions: (1) Genetics and Physiology; (2) Nutrition and Incubation; (3) Pathology and Disease Control; (4) Economics, including Processing and Marketing; and (5) General.

All communications regarding the Congress should be addressed to W. D. Thermohlen, Secretary General, Seventh World's Poultry Congress and Exposition, United States, Department of Agriculture, Washington, D.C., U.S.A.

All-India Obstetric and Gynecological Congress, 1939.—The Third All-India Obstetric and Gynecological Congress will be held in Calcutta in December 1939. The principal subjects of discussion are (1) anæmia of pregnancy, (2) functional uterine hæmorrhage, and (3) maternity and child-welfare. The Provisional Scientific Committee have formulated a scheme to facilitate investigations on these subjects. All communications are to be addressed to the Secretary, Dr. S. Mitra, M.D., F.R.C.S., F.R.C.O.G., 3, Chowringhee Terrace, Calcutta.

A New "Nomenclator Zoologicus."—Professor Julian S. Huxley, Secretary, Zoological Society of London, writes:—The preparation of this work, respecting which an announcement was made in 1935, is now approaching completion. It constitutes an attempt to bring together the names of all the genera and subgenera in Zoology that have been described from the 10th edition of *Linnaeus*, 1758, up to the end of the year 1935, with a bibliographical reference to the original description of each. It will also

include the great majority of alternative spellings that have appeared during that period. Another feature that will, it is thought, be found valuable for systematists relates to cases where a new name has been proposed for a homonym. In these instances a cross-reference is given under the homonym to the new name.

It is estimated that the work will comprise some 225,000 entries, of which about 5,000 appear to have been omitted from all previous publications of this character. It is proposed to publish the work in 4 volumes of nearly 1,000 pages each, which it is hoped it will be possible to issue at intervals of about six months.

The Zoological Society of London has already borne the whole cost of preparation (approximately £1,800), but the Council of the Society does not feel justified in incurring further expenditure in respect of this enterprise, which would involve an additional £3,600.

However, with the aid of various grants from outside sources, the Editor, Dr. Sheffield Neave, has himself now been able to arrange for the printing and publication of the work. It is proposed to publish it at the low advance-subscription rate of six guineas post free for the four volumes, provided that a sufficient number of undertakings to subscribe can be obtained. (Intimation may be sent to Dr. S. A. Neave, O.B.E., Imperial Institute of Entomology, 41, Queen's Gate, London, S.W. 7.) If these are adequate, it is hoped to issue the first volume during the coming summer. After publication, the price will be raised to eight guineas.

Messrs. *The Veritas Press*, Inc., New York, announce that they will soon be publishing a comprehensive Thesaurus of Geology and allied scientific terms, under the authorship of Walther Huebner. The publication, which is the first of its kind in the history of geological literature, will explain and co-ordinate more than 25,000 geological terms in the English and German languages, covering exhaustively all branches of the subject. The price of the book, which will contain about 400 pages, will be $7·50, and the English-German Part is expected to be published in October 1939.

Considering the nature and scope of the work we have no doubt that this compilation will be welcomed, and its value appreciated, by geologists all over the world, who wish to be familiar with English and German geological literature.

Messrs. *Annual Review*, Inc., Stanford University, P.O. California, announce that the *Annual Review of Biochemistry*, Vol. VIII, 1939, will be ready by July 15, 1939. The volume will contain approximately 680 pages and is priced $5·00 per copy.

The non-profit Bibliofilm Service (*Bibliofilm Service*, U.S. Department of Agriculture Library, Washington, D.C.) copies, at cost, for serious research workers, extracts from almost all publications, except certain of those which are copyrighted) abstracted in *Chemical Abstracts*. Present rates are 1 cent per page plus a fixed service charge of 20 cents for copying in the form of microfilm (35 mm. standard safety photographic film conveniently usable in reading machines now widely available at moderate cost), or 10 cents per page, plus service charge of 20 cents, for copying as photoprints 6" × 8", readable without optical aid). When properly copyable material is not available in the four great scientific libraries where Bibliofilm Service has installations, it is usually borrowed from other institutions for copying, or copies through other services or in other cities at their somewhat varying rates (*Chemical Abstracts*).

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We acknowledge with thanks, receipt of the following:—

"Agriculture and Live-Stock in India," Vol. 9, Pt. 2.
"Journal of Agricultural Research," Vol. 58, Nos. 3–5.
"Agricultural Gazette of New South Wales," Vol. 50, Pts. III–IV.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 3.
"Biochemical Journal," Vol. 33, No. 3.
"Berichte der deutschen chemischen gesellschaft," Vol. 72, No. 4.
"Journal of the Institute of Brewing," Vol. 45, No. 4.
"Journal of the Indian Botanical Society," Vol. 18, No. 1.
"Biological Reviews," Vol. 14, No. 2.
"Communications from Boyce Thompson Institute," Vol. 10, No. 2.
"The Journal of Chemical Physics," Vol. 7, No. 4.
"Journal of the Indian Chemical Society," Vol. 16, No. 2.
"Chemical Age," Vol. 40, Nos. 1030–1033.
"The Calcutta Review," Vol. 71, No. 1.
"Chemical Products," Vol. 1, No. 6.
"Experiment Station Record," Vol. 80, No. 3.
"Indian Forester," Vol. 65, No. 5.
"Forschungen und fortschritte," Vol. 15, Nos. 10–12.
"Transactions of the Faraday Society," Vol. 35, No. 216.
"Genetics," Vol. 24, No. 2.
"Bulletin of Health Organization (League of Nations)", Vol. 6, No. 6.
"Calcutta Medical Journal," Vol. 35, No. 5.
"Bulletin of the American Meteorological Society," Vol. 20, Nos. 1–2.
"Scripta Mathematica," Vol. 5, No. 4.
"Journal of the Indian Mathematical Society," Vol. 3, No. 5.
"Indian Medical Gazette," Vol. 74, No. 4.
"Nature," Vol. 143, Nos. 3621–3624.
"American Museum of Natural History," Vol. 43, No. 4.
"Journal of Nutrition," Vol. 17, Nos. 3–4.
"Proceedings of the Royal Netherlands Academy", Amsterdam, Vol. 42, No. 1.
"Indian Journal of Physics," Vol. 12, Pt. VI.
"Canadian Journal of Research," Vol. 17, No. 2, A, B, C and D.
"Research and Progress," Vol. 5, No. 3.
"Journal of the Royal Society of Arts," Vol. 87, Nos. 4505–4508.
"Sky," Vol. III, No. 6.
"Indian Trade Journal," Vol. 132, Nos. 1712–1714.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

April 1939. SECTION A.—R. S. KRISHNAN: *Influence of Secondary Scattering on Depolarisation Measurements.* The secondary scattering which is very pronounced in emulsions and proteins enhances the values of ρ_M, ρ_V and ρ_H. This effect can be eliminated by using a very narrow pencil of light for illumination. M. AFZAL AND V. I. VAIDHIANATHAN: *A note on Capillarity and Subsoil Water-Table.*— A large number of concave menisci formed in the interstices near the surface exert a negative pressure, and hold down the subsoil water level. S. BHAGAVANTAM AND CH. V. JOGA RAO: *Ultrasonic Velocity and the Adiabatic Compressibility of some Liquids.*—The adiabatic compressibility derived from ultrasonic velocity and determined directly on the same specimens of liquids, are found to be in good agreement. B. RAMAMURTI: *A Special Net of Quadrics.* BAWA KARTAR SINGH: *The Space Arrangements of Atoms—Part I. The Configuration of Nitrogen in the 3-Covalent State.*—It is deduced from stereochemical considerations that the nitrogen valencies are non-planar. S. RANGASWAMI, T. R. SESHADRI AND J. VEERARAGHAVIAH: *Constitution of Naringin.*—The position of the sugar group. Glucose and rhamnose exist as a disaachraride unit attached to position 7. G. R. PARANJPE, Y. G. NAIK AND P. B. VAIDYA: *Scattering of Light by Large Water Drops. Part I, and Part II.*—Mie's theory has been extended to larger sizes of particles of radius varying from 0·4μ to 3·0μ. The corresponding experimental studies on steady clouds confirm the calculated angular distribution of intensity and its dependence on the particle size. P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part VIII.—Constitution of Herbacitrin and Quercimeritrin.* Herbacitrin is the 7-glucoside of Herbacetin and Quercimeritrin in the 7-glucoside of Quercetin.

April 1939. SECTION B.—B. N. SINGH, K. N. LAL AND M. B. LAL: *The Influence of Artificial Fertilisers upon the Photosynthetic Efficiency of* Andropogon Sorghum. B. N. SINGH AND S. R. A. N. RAO: *Photosynthetic Efficiency of Leaves as Influenced by Variations in pH of the Injected Solutions.* K. BHASKARAN NAIR: *The Reproduction, Oogenesis and Development of* Mesopodopsis orientalis *Tatt.* B. R. SESHACHAR: *On a New Species of* Urœotyphlus *from South India.*

Indian Chemical Society:

February 1939.—J. C. GHOSH: *The Production of Optically Active Substances and Metallic Films of Silver, Platinum and Palladium by means of Circularly Polarised Light.* TEJENDRA NATH GHOSH AND DEBABRATA DAS-GUPTA: *Pyrazole Derivatives.* S. K. RANGANATHAN: *-isoPropylglutaconic Acid.* V. S. PURI AND V. S. BHATIA: *The Action of Inorganic Colloids on Electrodeposition of Nickel.* B. N. GHOSH, P. K. DUTT AND D. K. CHOWDHURY: *Enzymes in Snake Venom—Part V. Detection of Dipeptidase, Polypeptidase, Carboxypolypeptidase and Esterase in Different Snake Venoms.* S. G. CHAUDHURY AND M. K. INDRA: *On Theories of Adsorption Indicators.* SURESH CHANDRA SEN-GUPTA: *Studies in Dehydrogenation—Part III.* BALWANT SINGH AND SOHAN SINGH: *Potentiometric Studies in Oxidation-reduction Reactions—Part V. Oxidation with Potassium Chlorate.* U. P. BASU AND S. J. DAS-GUPTA: *Acridine Derivatives as Antimalarials—Part II.* S. K. RANGANATHAN: *Experiments towards the Synthesis of Physiologically Active Lactones—Part I.* Cyclo*Pentyl-* and Cyclo*Hexylsuccinic Acids. Resolution of* dl-cyclo*Pentylsuccinic Acid.*

Indian Botanical Society:

April 1939.—H. G. CHAMPION: *The relative stability of Indian vegetational types* (Presidential Address at the 18th annual meeting of the Indian Botanical Society at Lahore, January 1939). C. V. KRISHNA IYENGAR: *Development of the embryo-sac and endosperm-haustoria in some members of Scrophularineæ II.* Isoplexis canariensis, *Lindl and* Celsia coromandeliana *Vahl.* M. J. TIRUMALACHAR: *Grafting of Figs.* K. R. RAMANATHAN: *On the mechanism of spore liberation in* Pithophora polymorpha *Wittr.*

Meteorological Office Colloquium, Poona:

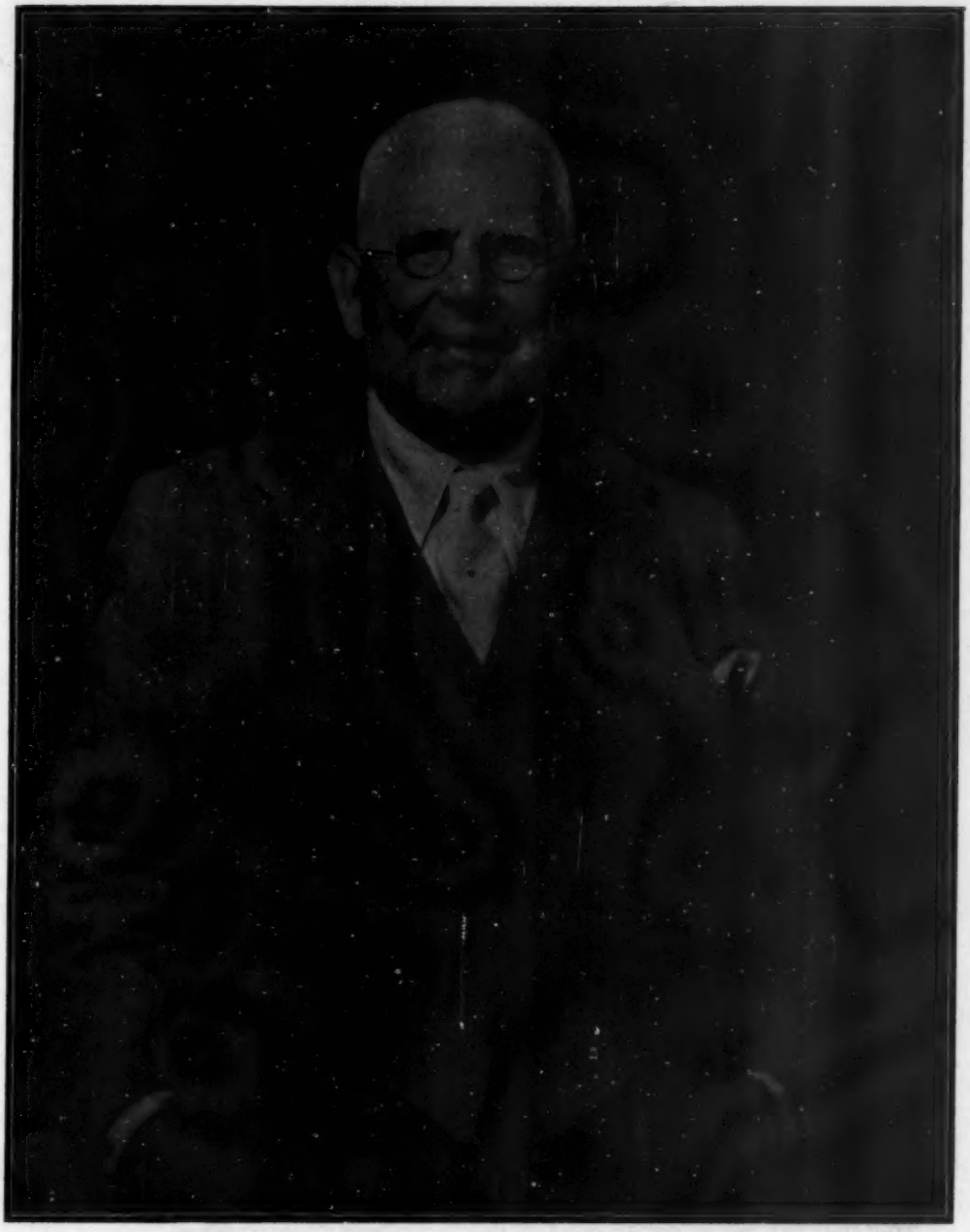
March 3, 1939.—DR. K. J. KABRAJI: *A summary of work on droplet sizes in mountain fogs at Khandala and of conclusions therefrom. March* 10, 1939.—MR. J. M. SIL: *Vaisala's Radiometeorograph.* DR. K. R. RAMANATHAN: *Thomas's Radio-meteorograph. March* 16, 1939.—DR. L. A. RAMDAS: *Some Problems on Radiation. March* 31, 1939.—MR. M. P. VAN ROOY: *Climate of South Africa. April* 21, 1939.—S. P. VENKITESHWARAN: *Bureau of Standards Radio-Meteorograph.*

Society of Biological Chemists, India:

February 18, 1939 (Bangalore)—G. NARASIMHA MURTHY: *Electrical Mobilities of Red Blood Carpuscles in Laboratory Animals during Malnutrition.* Y. V. S. MURTHY AND Y. V. S. RAU: *Calcium and Phosphorus Availabilities in Rice.* P. M. N. NAIDU: *The Test-tube Chick.*

(9-4-39—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore

With the Compliments of "Current Science"



SIR RICHARD GREGORY, BT., D.SC., F.R.S., LL.D., F.R.MET.SOC., F.INST.P.

CURRENT SCIENCE

Vol. VIII] June 1939 [No. 6

The Imperial Agricultural Research Institute

THE Scientific Report of the Imperial Agricultural Research Institute, for the year ending June 1938, records the results of work during the first year of its settled existence in its new home, after its transfer from Pusa to Delhi.

It will be recalled that when, as the result of damage to the Institute at Pusa by the devastating earthquake in January 1934, the Government of India decided to transfer the Institute to Delhi, misgivings were felt in some quarters whether owing to soil and climatic differences, the work on many important crops could be continued at Delhi from the point at which it was left at Pusa. It is gratifying to note from the report that the actual results obtained with several crops belied the apprehensions, and that the continuity of the programme of field research and experiment has not suffered by the transfer.

The Imperial Agricultural Research Institute, familiarly known as the Pusa Institute, has successfully striven, since its establishment in 1903, to advance the nation's most vital industry—agriculture—by bringing science and agricultural practice into close contact. As a central research organisation, the Institute made great and enduring contributions to the improvement of agriculture and to the scientific knowledge of the agricultural problems of the country, during the past three decades. The Institute at Pusa, being the first of its kind in the country, provided for many years the main stimulus for agricultural research. Many recent agricultural developments in the country owe their foundations to the constant care and wider imagination exercised in seeking for the directions of advance, and in giving the lead which the Institute had offered in the early days of agricultural research in India.

On the practical side, tangible economic results have accrued to the cultivator from the improvements effected by the Institute

in the fruitful fields of crop and animal husbandry. The Pusa wheats speedily earned a distinction and spread even beyond the borders of India. The remarkable development in the Indian sugar industry is due in a great measure to the planned researches conducted at the Coimbatore Station of the Institute. Coimbatore sugarcane has definitely become a household word in the sugarcane growing tracts. The work on tobacco and its flue-curing have enabled the production of tobacco leaf of the colour, necessary for the modern cigarette, and have contributed to developments in the cultivation, trade and industry of cigarette tobacco. In a previous report and in a popular account of the work of the Institute, the Director has stated, we believe on justifiable grounds, that the increase in the agricultural income to the cultivator in one year directly arising from the work of the Institute, exceeds the total amount of money spent on the Institute in thirty years.

The scientific work leading to these practical achievements is a long list of impressive scientific papers on soils, fertilisers, crops, pests and diseases, contributed mostly to the scientific publications of the Institute, popularly known as Pusa Memoirs and Bulletins.

The transfer of the Institute from Pusa to Delhi, marks a new epoch in the history of agricultural research in India, and coincides with important developments and new ventures in the science and practice of agriculture in India. There have been important developments within the agricultural industry itself. The economic significance of Indian agriculture is not now confined to the production of food crops and peasant agriculture. Power farming on estate basis and intensive cultivation are developing. Movements in marketing organisation and the introduction of grades and standards demand in agricultural produce a very high quality for trade and industry. A more recent and a very important development is the interest in national nutrition, which calls for the production of sufficient food with high nutritive value. These insist upon fresh knowledge on problems of soil fertility, cultivation and plant nutrition and in the ways of protecting crops from damage by insect pests and disease, paying due regard to the fact, as it is known now, that the nature and intensity of the processes in the soils and crops of the tropical and sub-tropical regions are different from those that obtain in temperate regions. The programme of research and investigation besides being a continuation or the corollary to the work that has been in progress requires such modifications or additions as are demanded by current problems and the trend of future developments.

In the report under review, the Director of the Institute introduces the scientific work of the year in the different sections of the Institute and gives a general survey of the nature of problems under study and the objective thereof, mainly for the information of the non-technical reader.

A perusal of the Report has convinced us that the Director and his colleagues are intensely alive to the problems of contemporary scientific agricultural practice. The active programme of research at the Institute is based on the recognition of the vital need for greater production, having regard to the increasing demands of the consumer and a safe margin for the producer; but what is important is the realisation of the fact that the degree of economic success of the agricultural industry depends on the extent to which various other subsidiary industries of the farm such as crops, livestock, implements, processing of produce,

utilisation of waste, can be blended into a harmonious whole.

Several new and interesting lines of study are described in the Report under review. The studies on the theory and practice of mixed farming are of inestimable importance to Indian agriculture as a means of maintaining soil fertility, which is the main link between land and stock. These studies have for their objective the judicious blending of crop and animal husbandry so that the land supports the animal and the animal comes to the relief of the land as far as possible. Interesting results are recorded from early maturity and early mating experiments in the investigations on cattle breeding for milk production. It would appear, from the results of experiments which have been in progress for seven years, that the progeny of early matured and early mated heifers and bulls, can in no respect be considered inferior to the progeny of animals that ordinarily mature late and, therefore, mated late, in appearance, stamina or in milk yield per lactation. This means that bringing animals to early maturity and mating them early, give a greater number of lactations, an increase in the number of calvings and a more abundant supply in the total milk yield in the animal's life. Another very striking and interesting result is that obtained from stimulation experiments. When uncovered heifers are stimulated, they yield milk with normal composition and proper nutritive value. Stimulation of the act of milking and manipulation have apparently a much greater effect than hitherto supposed.

The study of the all-important soil condition as a medium for crop growth is directed to exploring the possibilities of increasing fertiliser and manurial efficiency in crop production. Connected with this is the investigation on the nutritive value of foods and fodders as influenced by the nature and extent of nourishment given to crops, and this will reach its culminating point in the evolving of a rational system of manuring for higher crop production. Another important and interesting line of study is that on the fixation of atmospheric nitrogen in the soil by itself and by leguminous and cereal crops. A clearer understanding of the mechanism of the processes of fixation under Indian conditions and the conditions that favour it is likely to lead to methods of cheap nitrogen nutrition of soils and crops by suitable soil management and crop rotations.

New lines of work in the evolution of crops are taken up. Breeding crops for drought and disease resistance has reached a stage at which knowledge is required on the application of modern theories of heridity in the further advance on plant breeding work. These are being studied in the field and in the laboratory in connection with the problem of breeding wheats which are comparatively resistant or immune to the attack of rust disease in India, and the breeding of disease-resistant potatoes. Few achievements of the Institute are more widely known than the contributions made by sugarcane research. Particular attention has been directed to the production of canes suited to the requirements of the sugar industry both in regard to quality and quantity. A very notable line of work in sugarcane breeding is the hybridisation between bamboo and sugarcane. It is perhaps too early to visualise the economic possibilities of such crosses, but the fact remains that a new line of work has been opened up, which may have a far-reaching effect in course of time.

It is one thing to grow better and more

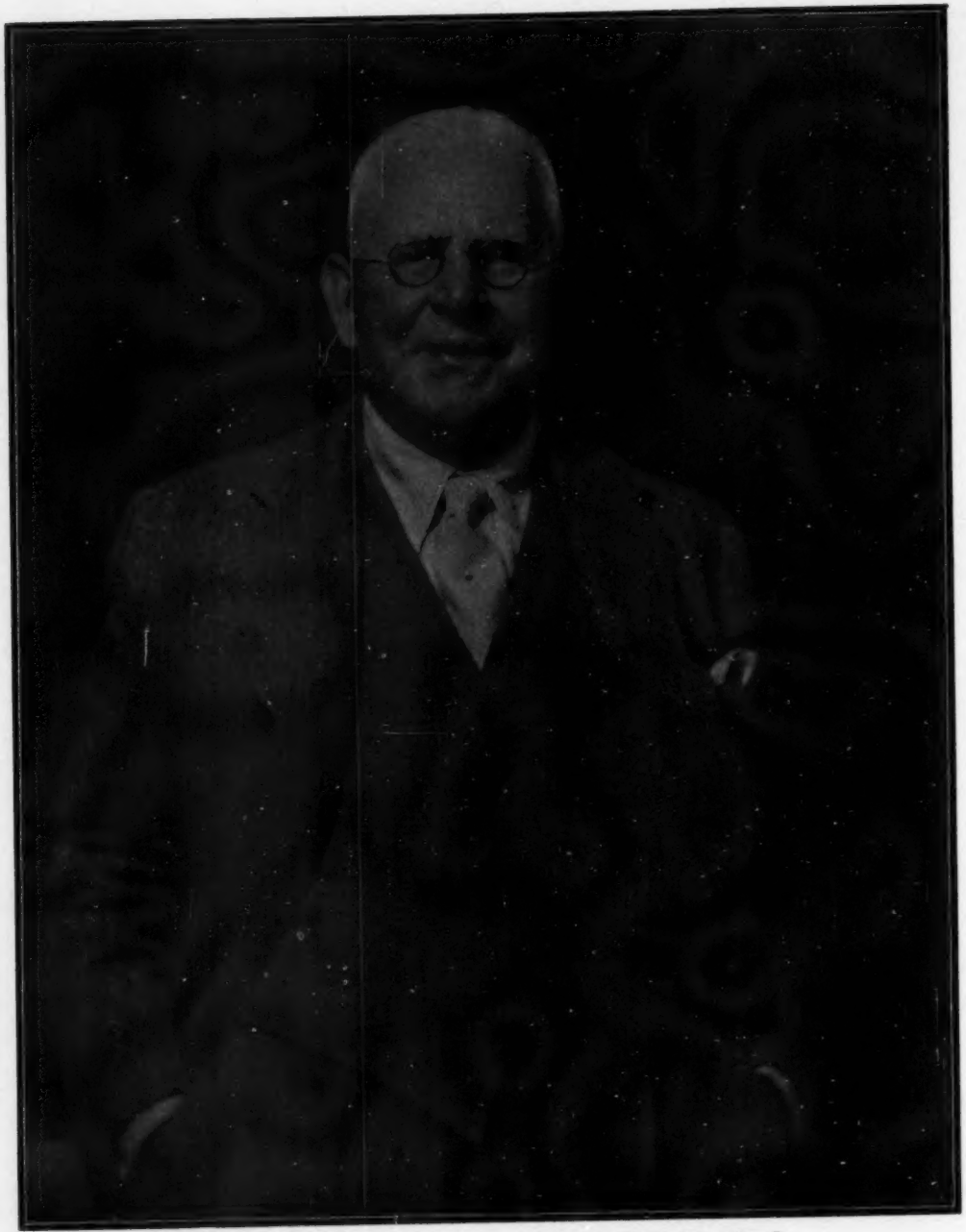
crops, and it is a different matter to protect the crops from the ravages of insect pests and diseases and to gather the harvest in full. Ecological studies on insects, and surveys of important diseases of crops and breeding and testing of crops for disease-resistance are new lines of work, aimed at controlling insect pests and diseases of crops. Particular attention was paid during the year to researches on the control of borer pests of sugarcane about which widespread concern is felt in the cane-growing tracts.

While the Imperial Agricultural Research Institute, as its name implies, is well known for its research activities, it is not adequately realised that it is both an educational as well as a Research Institute. It gives post-graduate courses for higher instruction in different branches of agricultural sciences. During the year under report ten post-graduate students successfully completed their course and qualified for the Diploma of the Associateship of the Institute, and three completed one year course in Farm Organisation and General Farm Engineering, while four students were admitted for short periods of study in special subjects. The provision for post-graduate instruction at the Institute is a wise step, for the demand for research should be met by a steady supply of trained workers. It is only fitting that, in an agricultural country like India, the supply of trained workers should come from an institution within the country.

In opening the Institute on 7th November 1936, H. E. the Viceroy, whose solicitude for agricultural development and everything that pertains to the improvement of the village population is well known, concluded his address with the following significant words:—

> "The Institute has in it, I am confident, the power for further service of infinite value to India; alike to the Provinces and to the Indian States. Its tradition and its reputation are those of established distinction. It has been served by many able and distinguished men with a loyal and disinterested devotion throughout the many years of its existence. I am confident that the present staff will amply sustain the past record of the Institution for scientific achievements of the highest standard. In to-day declaring open its new home I do so with the wish, which all of us share, that, under its new auspices, its future may even be more brilliant and the service it renders to India even more distinguished than ever before."

Under the distinguished administration of the present Director and with the active and energetic co-operation of his loyal colleagues, the Institute has already fulfilled the ardent wish of H. E. the Viceroy, and the more beneficent results of successful scientific experiment which the Institute may yet produce will, besides enhancing its prestige, make momentous contribution to national well-being and prosperity. India's wealth is its soil, its pillars are the villager and his cattle. Science must arm the one with knowledge and protect the other in the production of more wealth. This task is as arduous as its responsibilities are great. We confidently rely on the inspiring guidance of the Director and the devotion of his staff for results which would ensure the steady and increasing prosperity of the agricultural population.



SIR RICHARD GREGORY, Bt., D.Sc., F.R.S., LL.D., F.R.MET.SOC., F.INST.P.

Sir Richard Gregory, Bart, F.R.S.

WHEN it was decided in 1932 to produce for India a general scientific journal which would command the interest and support of the leading men of science of the country, it was natural that the originators of the project should turn to editors of journals of similar character outside India for advice and help. As a result, Sir Richard Gregory, of *Nature*, Dr. Arnold Berliner of *Die Naturwissenschaften*, and Dr. J. McKeen Cattell of *Science*, agreed to become corresponding editors of *Current Science*. The interest that Sir Richard Gregory then showed in the new Indian journal has continued in the years that have followed; and his retirement at the end of last year from the editorship of *Nature* is an appropriate occasion on which to review his services to science, in India and elsewhere. As his successors on *Nature*, we welcome the invitation of the editor of *Current Science* to attempt such a survey.

To a large extent, the story of Sir Richard Gregory's work for science is bound up with the history of *Nature* during the past forty-five years. He joined the journal in 1893 as sub-editor to Sir Norman Lockyer; but before that he had been a contributor of occasional notes, while he was working at the Royal College of Science as a research assistant to Sir Norman Lockyer. In those early days, as he himself has said, his interests were divided roughly in the ratio of three parts astronomy and one part general science. He was associated at the Royal College of Science with men like T. H. Holland, better known as Sir Thomas Holland, formerly Director of the Geological Survey of India and at present Principal and Vice-Chancellor of the University of Edinburgh, and H. G. Wells, whose reputation as a writer of scientific romances—many of which have proved almost prophetic—and of sociological works, is world-wide. Early efforts at scientific journalism took the form of notes of scientific progress contributed to weekly and monthly magazines. With Sir Richard's appointment to *Nature*, however, his activities began to extend to wider fields. Astronomy began slowly to give way before his growing interest in scientific progress in general. Nevertheless, Sir Richard has always retained his special interest in astronomy, though he would be the first to admit that it no longer holds its early place in his affections.

Sir Richard joined *Nature* at a time when a new era was opening up in science. Lord Rayleigh had recently completed his work on the density of nitrogen, and in association with Sir William Ramsay, traced the discrepancies he observed to the presence in the atmosphere of a hitherto unknown gas, argon. This discovery led to the examination of other sources of nitrogen, with the result that Sir William Ramsay, by means of the spectroscope, found in the mineral cléveite a gas which proved to be identical with an element discovered by Sir Norman Lockyer in the sun twenty-six years earlier and named by him "helium". In 1896, came the discovery of X-rays, by Röntgen, radium was discovered by Pierre and Mme. Curie in 1898, and shortly afterwards the work of Sir J. J. Thomson on the cathode rays, which showed that they consisted of a stream of swiftly moving units of negative charge which were christened "electrons".

The twentieth century began with the tide of discovery in the new sub-microscopic and sub-atomic physics running strongly. Developments during the years that followed have led to complete revision of our views on the structure of matter and on the fundamentals of physics and chemistry and also of biology. *Nature*, under Sir Richard's guiding mind, has played a notable part in this progress, many of the steps of which were first announced in its pages. The well-known section headed "Letters to the Editor" now occupies four times the space it did in the nineties of last century, and it is a recognized place for recording the progress of scientific investigations. The growth of this part of *Nature* has been due in no small degree to Sir Richard's own wide knowledge of science and friendship with its disciples. Keen and critical himself, he has always been willing to give a sympathetic ear to a scientific worker who has honestly attempted a piece of research, and, so far as considerations of space permitted, he has given him the opportunity of describing his results for the information and attention of others. Destructive and discouraging criticism have always received a swift repulse.

This same kindly yet fearlessly judicial mode of approach has characterized the whole of Sir Richard's conduct of *Nature*. In leading articles, controversial issues have been brought forward and lines of action suggested, but always with the object of

advancing science and its application to human affairs. In reviewing books and other publications, he enlisted the aid of leading workers in the subjects under discussion. By these means, he has enhanced the prestige of *Nature*, and indeed of science itself, wherever progressive and enlightened views are acceptable. His reward came in 1933, when he was recovering from a serious illness, with the announcement that he had been made a Fellow of the Royal Society, under a special Rule of the Society, which provides for the election of persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society".

Scientific workers in India owe a particular debt of gratitude to Sir Richard Gregory. Their work has always been given careful, if critical, consideration, as indexes of *Nature* will quickly show. In this connection it is worth while recalling that the effect now known by Sir C. V. Raman's name was first announced to the scientific world in a communication from him and Prof. K. S. Krishnan which appeared in the columns of *Nature* in 1928, while the original researches of Prof. M. N. Saha and the Allahabad school have also received due notice. For many years, too, the late Sir J. C. Bose used the columns of *Nature* in bringing his many investigations, first in electro-physics and later in plant physiology, to the notice of his scientific colleagues. Support has also been given to such projects as broadcasting in India and to proposals which led to the inauguration of the National Institute of Sciences, while the activities of the Indian Science Congress Association have been followed sympathetically. Sir Richard's personal interest in Indian affairs was much enhanced by his brief but intensive tour of the country in 1933. The knowledge that he thus obtained at first hand of Indian conditions has made a deep and lasting impression on him.

So much, inadequate as it is, for Sir Richard Gregory's work for science through *Nature*. There is another side of his activities which, though equally important, has not received so much attention. His early experiences as a teacher convinced him of the important part played by suitable science text-books in schools. He set to work, therefore, to prepare text-books in which scientific methods of direct observation and experiment were given essential importance, and alone and in association with others, he has written numerous books of this kind and edited many others, all of which are marked by accuracy of statement and practical outlook. Many of these books, which have been published by Messrs. Macmillan & Co., Ltd., will be well known to students and men of science in India. As one of the founders of the *School World*, and joint editor of the *Journal of Education* with which it became incorporated, Sir Richard's influence upon educational progress is appreciated also in fields outside those of natural science.

From his early days Sir Richard has been convinced of the importance of science to the progress of civilization, and he has lost no opportunity in *Nature*, in the lay Press, and on the public platform of pointing out the contribution it can make to the welfare of mankind. For many years he played a leading part in the activities of the British Science Guild, now absorbed in the British Association for the Advancement of Science, and his latest distinction is his election as Chairman of the newly founded Division for the Social and International Relations of Science of the Association. Here he has the difficult task of steering the new Division on its maiden voyages, restraining the eagerness of the over-enthusiastic and stimulating the fearful who seek to draw back whenever science touches on political affairs. There can be little doubt that, in his experienced hands, the Division will be quickly recognised as a forum for the objective discussion of the innumerable borderland topics provided by the impact of progressive science on society.

Sir Richard Gregory, who was within a few weeks of his seventy-fifth birthday when he retired from the editorship of *Nature*, has laid the world under a debt of gratitude for his persistent advocacy of the importance to mankind of the unfettered prosecution of scientific research and its application to everyday affairs. Happily he is still vigorous in body and spirit, and his release from routine duties will enable him to devote yet more attention than in past years to the subject nearest his heart—the gospel of science.

A. J. V. GALE.
L. J. F. BRIMBLE.

Professor Walter Nernst

ON June 25, Professor Walter Nernst attains the seventy-fifth year of his life. The news will be a source of pleasure and satisfaction to his numerous pupils all over the world, and will be welcome to every body interested in science. There is hardly any scientist in this country who will not desire to join with his brother-scientists in Germany and other countries in offering Professor Nernst his warmest congratulations and in wishing him many more years of happy and active life.

It will be appropriate to the occasion to recall here some of the fundamental contributions of Prof. Nernst to Thermodynamics and Physical Chemistry. These contributions and discoveries now form an essential part of the frame-work of Physical Science and are well known to every student of Physics and Chemistry. The new "Heat Theorem" also called the third law of Thermodynamics or the principle of the Unattainability of the Absolute Zero, was first put forward in a paper published in January 1906 in the *Nachrichte der Gesellschaft der Wissenschaften Zu Gottingen*. It solved a problem which the first and second laws of Thermodynamics alone were unable to solve, namely, the calculation of Maximum work or free energy (A) from purely thermal data. The agreement between the values of A calculated on the basis of this theorem and the values obtained directly from measurements of vapour pressure, solubility or electromotive force, as also the calculations of transition points from the condition $A = 0$, provided sufficient justification for the assumptions underlying the new theorem. A direct evidence was also available in the experimental confirmation of the idea developed by Prof. Nernst in the paper referred to above, that the specific heats of all solid substances without exception assume negligibly small values at very low temperatures. The new theorem was, at first, applied to condensed system, i.e., systems in which only liquids or solid substances are present. But it was later on found possible to extend it to gaseous systems also. The great utility of the extension of the theorem in this direction lies in the fact that it enables us to predict the position of equilibrium of a reaction that has never been studied experimentally. The new theorem required, for its test and application, reliable thermal data. This led Prof. Nernst to perfect methods for the determination of specific heats at low temperatures, in collaboration with Koref, Lindemann, Eucken, Pollitzer and Schwers. The result was the development of the vacuum calorimeter which has been successfully employed to obtain reliable data for the specific heats of solids and gases at very low temperatures. Incidentally, these experimental investigations yielded valuable information on the question of the general technique of low temperature work. The measurements of specific heats at low temperatures not only furnished reliable data for testing the validity of the new theorem, but also provided a foundation for the elucidation of Dulong and Petit's law and further theoretical advances in the theory of the solid state which have found expression in Debye's T^3-law.

PROF. WALTER NERNST

Investigations of gaseous equilibria at high temperatures by Prof. Nernst and his pupils and co-workers led to the improvement of old experimental methods and the perfection of new ones. Mention may here be made of the explosion method, in which high temperatures up to 3000° and even more are obtained by the explosion of a gaseous mixture in a closed bomb, the thermal conductivity method, the method of the semi-permeable wall in which platinum or iridium bulbs are employed, the method of the heated catalyst in which equilibrium is quickly attained by introducing a heated catalyst such as a platinum wire into the mixture, and the method of vapour density determinations at temperatures exceeding 2000°, in which small iridium bulbs are used. While speaking of equilibrium, one is at once reminded of Nernst's partition-law. The distribution of a solute between two liquid phases had been previously studied experimentally by Berthelot and Jungfleisch, but a thorough examination of the problem both from the theoretical and experimental aspect, was first undertaken by Prof. Nernst in 1891. Reference may also be made to his contribution to the subject of photo-chemistry. Every student of chemistry is familiar with his 'atom-chain reaction' theory which explains in a most satisfactory manner the high quantum efficiency of the reaction between hydrogen and chlorine under the influence of light.

The contributions of Prof. Nernst to the theory of solution are no less important and fundamental in character. In 1889, he put forward the theory of galvanic cells which explained the origin of electromotive force in terms of an "electrolytic solution pressure" of the metal electrodes and by a beautiful combination of kinetic considerations with thermodynamic reasoning derived an expression for the electrode potential, which is quite exact when the activity of the ion concerned can be set equal to its concentration. Other important work in this field includes investigations on diffusion in solutions, liquid contact potentials, solubility product relations and transport of water by ions.

The literary genius of Prof. Nernst has found expression in a number of writings, remarkable for their clear exposition of the subject and lucidity of style. His well-known text-book on "Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics" which was first published in 1893 and which has since appeared in a number of German and English editions, gives a masterly survey of the subject and remains indispensable to all students of chemistry. "The New Heat Theorem: its Foundation in Theory and Experiment" gives an authoritative, exhaustive and clear account of the theoretical and experimental investigations of the author and his co-workers on the subject. No serious student of physics and physical chemistry can do without this book. His "Experimental and Theoretical Applications of Thermodynamics to Chemistry" has appeared in a number of German and English editions. Besides, he has edited the *Zeitschrift fur Electrochemie*, the *Jahrbuch der Electrochemie*, and the *Zeitschrift fur Angewandte Chemie*.

It has not fallen to the lot of many to achieve what Prof. Nernst has been able to achieve in the field of Scientific Inquiry. His work which covers a wide field in physical science and extends over a period of nearly half a century, has already secured for him a high place among the scientists of all times. Let us hope and pray that he may live long to watch the results of his labours and make further valuable additions to the sum-total of human knowledge.

M. QURESHI.

LETTERS TO THE EDITOR

A Magnetic Study of the Oxides of Chromium and Manganese

The magnetic properties of the metallic oxides have not been investigated as completely and systematically as those of their salts. In literature the values of magnetic susceptibility reported by different workers for a particular oxide are found to vary widely and there are few precise determinations of the susceptibility changes with temperature. Thus ferric oxide which is usually paramagnetic is also reported to exist in a ferromagnetic form and the value of χ obviously depends upon the mode of its preparation. Similar variations have been noticed for nickel and cobalt oxides. The value of χ for chromic oxide ranges between 19×10^{-6} and 40×10^{-6} (Bornstein's "Tabellen") although a ferromagnetic variety has also been claimed by Faraday,[1] and Nilson & Petterson.[2] The manganese oxides behave similarly.

The susceptibility values of the salts of transition elements, in general, are in fair accord with Hund formula $\mu_B = \sqrt{4S(S+1)}$ for spin only but when the oxides are taken into consideration, the agreement is not at all good. Cameron, Harbard and King[3] believe that none of the oxides of transition metals gives values which are in accord with theory. In spite of this, it is remarkable that the order of susceptibility values of the oxides in different valency states is qualitatively that suggested by theory. These peculiarities may be due to wide deviations from the Curie Law and the present investigation on the chromium and manganese oxides was undertaken in order to see whether Weiss modification of the Law should give better concordance with theory, since the distortions produced by interatomic forces, which are principally responsible for these wide divergences, are taken account of by introducing θ in the Curie Law.

The susceptibilities of the oxides were measured between 293° K. and 580° K., on a modified form of Gouy's magnetic balance. In the main it has been possible to substantiate the following points:

(*a*) that the susceptibility value of chromic oxide obtained by (i) the dehydration of chromium hydroxide, (ii) by the ignition of chromic anhydride, and (iii) by the ignition of ammonium dichromate at a temperature of 800° C. is $25{\cdot}6 \pm 0{\cdot}2 \times 10^{-6}$ at room temperature. The χ, T curve, in each case, exhibits a maximum at higher temperatures, ranges between —400° and the value of θ obtained from $1/\chi$, T curve at higher temperatures, ranges between —400° and — 485°. This gives for μ_B a mean value of 3·63 which is in fairly good agreement with the theoretical value 3·87 for trivalent chromium.

(*b*) that μ_B value for monohydrate of chromium dioxide $CrO_2 \cdot H_2O$, prepared by interacting chromium hydroxide and chromic acid, is 2·95 which compares well with the theoretical

value of 2·83 for quadrivalent chromium. The value of θ for this compound is negligible. In this connection, it will be of interest to note that Cameron, Harbard and King (*loc. cit.*) have recently questioned the existence of the dioxide.

(c) that manganese dioxide possesses the constitution O = Mn = O. On the Hund formula the μ_B value for quadrivalent manganese is 3·87 which is in excellent agreement with the observed value of 3·73. The value of θ for the compound is — 470°.

(d) that manganic oxide is represented by O = Mn — O — Mn = O, since the observed magnetic moment of 5·17 Bohr magnetons is in fair agreement with the theoretical value of 4·90 for trivalent manganese. The Curie point (θ) equals — 176 for this oxide.

(e) that for manganous oxide the observed magnetic moment of 5·91 agrees well with the calculated value of 5·92 Bohr magnetons for bivalent manganese. Tyler,[4] and Squire,[5] from the magnetic study of the oxide at low temperatures arrived at a similar conclusion. In this compound θ has a value of — 540.

From the foregoing it is clear that after making necessary corrections for θ, the experimental μ_B values agree excellently with the theoretical, particularly for manganese oxides. It suggests, therefore, that if due regard be paid to the purity of oxides and if distortions produced by the interatomic forces are taken into consideration by determining the value of θ, then the value of μ_B obtained experimentally agrees well with theory.

Full details of this work will shortly be published.

S. S. Bhatnagar.
P. L. Kapur.
Brahm Prakash.
University Chemical Laboratories,
Lahore,
May 29, 1939.

[1] Faraday, *Pogg. Annalen*, 1847, **70**, 33.
[2] Nilson and Petterson, *Ber.*, 1880, **13**, 1459.
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[4] Tyler, *Phys. Rev.*, 1933, **44**, 776.
[5] Squire, *J. Chem. Phys.*, 1939, 139.

Thixotropy of Liquid Helium?

The object of this note is to compare the properties of liquid helium with those of a colloidal substance exhibiting the phenomena of thixotropy, with a view to point out that the transition from helium I to helium II at the λ point may be thixotropic.

The well-known phenomena of isothermal reversible sol-gel transformation is known as thixotropy. The formation of the gel can be attributed[1,2] to the constituent particles becoming locked into place in equilibrium positions, wherein the Van der Waals force of attraction is just balanced by the force of repulsion due to the mutual repulsion of the double layer. The presence or absence of electrolyte regulates the effective spheres of action of the repulsive forces by regulating the value of the ζ-potential, and hence determines whether there is completely stable suspension, coagulation or the intermediate stage of thixotropy.

This change of structure is accompanied by a change, of viscosity, elasticity, density and double refraction. Kistler[3] finds that the dielectric constant does not change appreciably and Freundlich[4] finds that the velocity of electrically charged bodies, remains unaltered even when the sol is changed into a gel. Freundlich suggests that this may be due to a local softening of the gel, under the action of the electric current and thus providing a channel for the passage of the particle.

According to Freundlich[1] 'Loose-packing' and the formation of structures caused by an equilibrium between attracting and repelling forces are common to all thixotropic systems. But the nature of these forces—whether they are due to the particles or molecules—may be very different when passing from one system to another. Hauser and Reed[5] point out that the thermal transition from sol to gel is continuous and the only difference between sol and gel appears to be mechanical, hence they conclude that during the period of gelation some type of structure with mechanical resistance to shear is being built up out of the constituent particles

of the sol. This picture postulates a two-phase system.

PROPERTIES OF LIQUID HELIUM[6,7]

In the case of liquid helium McLennan[8] finds that when the pressure above the liquid is lowered slowly, there is a sudden change in the appearance of the liquid as the λ point is passed, rapid ebullition giving way to a perfectly clear and tranquil liquid. The latent heat of transformation is less than 0·002 cal./gm., and Ehrenfest[9] calls it a phase-change of the second order.

The properties of liquid helium that change at the λ point are the thermal conductivity, viscosity, and the specific heat, whereas the specific resistance and the optical properties are not appreciably changed. Keesom and Macwood[10] are not in a position to say whether the viscosity at λ point changes discontinuously.

Keesom and Taconis[11] took the Debye-Scherrer diagram of liquid helium. Liquid helium I gave rings similar to those of other liquids. The rings for helium II suggested a face centred cubic lattice, in which half the number of atoms have been removed in such a way that every atom and every hole is surrounded by six atoms and six holes. They point out that such an open structure explains the great heat conductivity. Keesom and Taconis[12] have also taken X-ray pictures of solid helium, and suggest an hexagonal close-packed structure. In connection with the structure of liquid helium II Keesom and Taconis[11] discuss the diamond lattice hypothesis of London[13] and Fröhlich[14] and find that this hypothesis is not in harmony with their X-ray data.

It appears that the λ point may be explained in the same way as thixotropy by assuming that during the transition some helium molecules become locked in place in their equilibrium positions in a loose-packed structure, whereas the holes may change their places; the position and arrangement of the molecules change during the transition, but the electronic configuration of the molecules remains appreciably unaltered. This picture would lead us to expect that at the λ point, the viscosity, elasticity, thermal conductivity and specific heat are primarily affected, while the changes in the electrical and optical properties should be of the second order. It may be remarked that this picture is in agreement with the experimental observations carried out at the λ point.

K. R. DIXIT.

Gujarat College,
Ahmedabad,
May 12, 1939.

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Methylation of Hydroxy-Flavonols

(Quercetin, Gossypetin and Herbacetin)

THE complete methylation of flavonols by the ordinary methods using dimethyl sulphate or methyl iodide is difficult since many of the substances undergo oxidation very readily in the presence of alkali. Diazomethane does not effect complete methylation in several cases. It has recently been shown by us[1,2] that methylation of all the free phenolic hydroxyl groups in glucosides of the flavonols can be indirectly brought about by treatment of the acetyl derivatives with dimethyl sulphate and alkali in acetone medium. We have now examined the suitability of this new method for methylating the flavonols themselves.

The methylation of quercetin through its acetyl derivative with dimethyl sulphate and alkali in methyl alcoholic solution was originally attempted by Cohn and Freudenberg[3] and as a result the completely methylated derivative, along with the partially methylated one (3:7:3′:4′-tetramethyl compound) was isolated. Acetone as solvent seems to possess a specific influence in promoting the methylation of the hydroxyl group in position 5. It has

now been found that *penta*-acetyl quercetin, when methylated with dimethyl sulphate and alkali as described already in one of our previous publications using acetone as solvent,[1] gives rise to the pentamethyl ether exclusively, and the yield is almost quantitative.

The hexamethyl ether of gossypetin was prepared by Perkin[4] through a laborious process by treating the flavonol with excess of methyl iodide and methyl alcoholic potash during two days. Besides the formation of other substances (probably partially methylated compounds) the nature of which Perkin could not characterise for want of sufficient material, the yield of the hexamethyl ether was not satisfactory. The action of diazomethane upon the flavonol does not produce the completely methylated ether, but a substance which melts at 166–68° and crystallises with five molecules of water. This substance is still under investigation. The hexamethyl ether can, however, be conveniently prepared by an application of the new method of methylation starting with the acetyl derivative. Hexamethyl gossypetin melting at 170–72° is obtained in very good yields.

We have recently shown that diazomethane does not completely methylate herbacetin,[5] and that the tetramethyl ether produced thereby (3:7:8:4′-tetramethyl herbacetin) undergoes further methylation with dimethyl sulphate and alkali in acetone medium to yield *O*-pentamethyl herbacetin melting at 156–58°. The pentamethyl ether has now been readily obtained by treating *penta*-acetyl herbacetin in acetone solution with dimethyl sulphate and alkali.

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April 26, 1939.

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[5] Rangaswami, Suryaprakasa Rao and Seshadri, *Proc. Ind. Acad. Sci.*, (A), 1939, **9**, 133.

Hysteresis in the Sorption of Water on Rice

The phenomenon of "Hysteresis in Adsorption" has attracted attention during the past few decades and has been interpreted from various points of view. Some of the systems investigated have charcoal,[1,2] gels of silica[3,4] and ferric oxide,[5] Gatton stone,[6] and platinum[7] as adsorbents. Organic natural colloids investigated, are comparatively few. Mainly cellulose[8] and its derivatives have been studied.

Physico-chemical investigations on rice by Sanjiva Rao[9] and co-workers have led to the view that rice is essentially a colloidal system intermediate between the lyogel and the xerogel. With a view to elucidate the nature of the phenomenon of hysteresis, sorption and desorption of water on rice were studied.

The technique adopted involved the use of the McBain-Bakr spring balance. Rice grains (the bran layer of which had been removed by polishing) were activated by dehydration at 65° C. vacuum. Successive sorptions and desorptions of water vapour were tried at 30° C. The results are indicated in Fig 1.

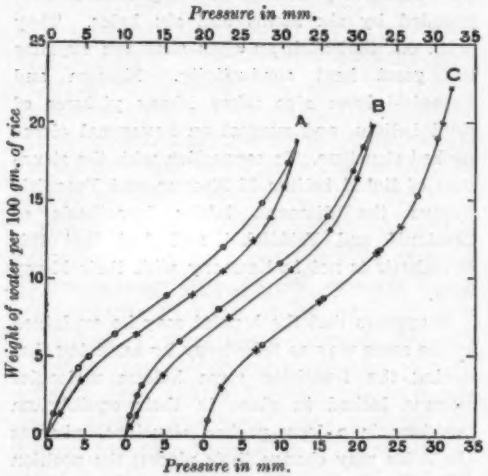

Fig. 1

Sorption and desorption of water on rice at 30° C.
A.—First sorption ×—×—× and desorption o—o—o
B.—Second ,, ,, ,, ,, ,,
C.—Third ,, ,, ,, ,, ,,

Rice gel behaves in a unique way unlike any other system yet studied in the fact that (*a*) when subjected to successive sorption and desorption, the hysteresis initially exhibited disappears, (*b*) the sorption capacity at the saturation pressure continuously increases.

McBain[10] has suggested that hysteresis is due to the filling up and emptying of cavities having narrow "necks". This explanation has hitherto been applied to hysteresis loops which are permanent and reproducible. The same concept can be employed to explain hysteresis and its subsequent disappearance in the case of rice. On its initial activation, rice has a rigid structure. Its capillaries have stable cavities and consequently rice exhibits hysteresis. When rice is subjected to successive sorption and desorption processes, the grain swells and the cavities now have elastic walls. With an increase in elasticity of the capillary walls, the cavities lose their power of trapping water. Thus at a certain stage (i.e., in the third series of sorption and desorption) the hysteresis loop completely disappears. As a result of the loosening of the structure of the rice grain, consequent on progressive sorption and desorption, the capacity for water at the saturation pressure continuously increases. The fact that the hysteresis loop extends down to zero pressure indicates that some of the cavities have "necks" of molecular dimension.

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June 2, 1939.

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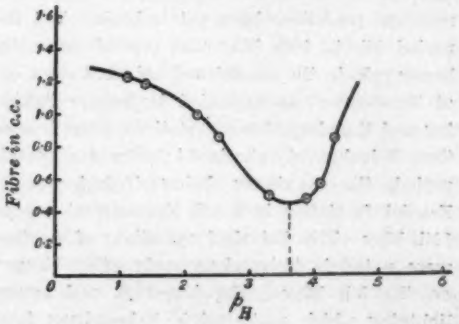
Adsorption of Ascorbic Acid by Lead Salts

In the course of our experiments on the isolation of ascorbic acid from *Phyllanthus embellica* (Indian gooseberry) it was found that lead acetate removes ascorbic acid, from an acid alcoholic extract of the dried powder of gooseberry pulp. The vitamin was found to be present in and removable from the precipitate. The fact that sulphuric acid was used for the acidification of alcohol, led to the suspicion that lead sulphate might be responsible for the adsorptive removal of ascorbic acid.

Experiments with an alcoholic solution of pure ascorbic acid (B.D.H.) acidified with sulphuric acid, showed that lead sulphate formed by the addition of lead acetate, removes ascorbic acid and it was further found that the quantity adsorbed depends upon pH. A study of the pH dependence on the removal of ascorbic acid by lead sulphate in the mixture was made, employing a standard alcoholic solution of ascorbic acid. pH of the reaction mixture was measured by the glass electrode and during all operations, an inert atmosphere was constantly maintained to prevent losses of ascorbic acid by atmospheric oxidation. The results are given in Table I and graphically represented in Fig. 1.

Table I.

pH	1·14	1·43	2·18	2·53	3·33	3·98	4·12	4·28
Tillman–Titre of filtrate after adsorption	1·21	1·2	1·0	0·86	0·50	0·48	0·67	0·84



It will be seen from the table and the graph that the optimum pH for the removal of ascorbic acid lies somewhere about 3·9. Further studies on the adsorption behaviour of other insoluble lead salts, are in progress.

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The Advance Monsoon in the West Coast

IN Travancore and Malabar there is usually a period of transition in May from the thunderstorm season of April to the south-west monsoon of June. Whereas the heat storms in April occur irregularly and the rain associated with them falls towards afternoon hours, i.e., just after the period of maximum insolation, there occurs a change in May due to the advent of the monsoon winds resulting in more extensive thunderstorms and heavier rains not always confined to the afternoon hours. This condition may sometimes precede the burst of the regular monsoon by a few weeks or otherwise merge into it quickly without any break. Rarely does the actual monsoon current establish itself without such a transition period which is called the advance monsoon for that reason.

This year's advance monsoon conditions in Travancore area were remarkable for their suddenness and intensity, and also for the distinct break which has set in its wake. The monsoon conditions have yet to begin. But the period 5th to 10th May was one of unusually heavy rain in the coastal and submontane areas of Travancore, accompanied by severe lightning and thunder. Several stations gauged more than 7 inches of rain in 24 hours during this period, the maximum being 10·9 inches at Eraniel (a station in South Travancore) on the 10th May. The disturbed conditions of weather were noted in Trivandrum only after 11 p.m. on the 5th May. The incessant and severe lightning which continued in Trivandrum from about midnight till 1-30 a.m. on that night created general panic. This was accompanied by stormy winds and heavy rain, the wind reaching gale velocity (45–50 miles per hour) for about 5 minutes during the peak of the storm. Several big trees were uprooted and considerable damage caused to the telephone and town electric supply systems. The barograph at the Trivandrum Observatory recorded a rise of 0·07 inch pressure during the height of the storm and the hyetograph recorded 1·5 inches in about 15 minutes. This was evidently the result of the intrusion of moist monsoon winds into the drier tropical air and the consequent instability set up in the atmosphere. One could easily distinguish this type of thunderstorm from the afternoon heat storms of April. Whereas the latter storm would travel from the land area towards the sea, this travelled just the reverse way.

A feature of the advance monsoon of this year that appears noteworthy is that the monsoon current which produced the above instability of the atmosphere and such heavy rains in the coast and submontane areas for nearly 5 days was not strong enough to reach the Western Ghats. Not a single hill-station in the Devicolam High Ranges and other portions of the Ghats facing Travancore recorded any appreciable rainfall during this period. After the 10th May, perfectly clear and hot weather prevails till this day and the regular burst of the south-west monsoon is awaited.

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Microscopic Characters of Some Manganese Minerals, found in the Lateritic Manganese-Ore of Belgaum District, S.W. India

THE manganese ore occurs in the high-level laterite in the Belgaum District. The Dharwar gneiss and schists of Archæan age have been decomposed by weathering, giving rise to

lateritic rocks *in situ*. The manganese ore which is found to be associated with the laterite has been formed by metasomatic process.

On examining the ore by means of an ore-microscope, I have found two minerals—hollandite and romanéchite, which are not yet known to occur in the secondary manganese deposits of India. They are found to be formed side by side with psilomelane and polianite which are the two essential mineral constituents of the ore. I have determined the reflecting power of these minerals by the method of Prof. J. Orcel[1] with different photo-electric cells, sensitive to different wave-lengths.

Psilomelane is the principal constituent of the ore, it is isotropic, the reflecting power of this mineral has been found to be 0·263, for λ 6500Å, using a photoelectric cell of "couche d'arret" type with filter (Wratten No. 29F).

The etch test gave the following results. HCl 1:1 dilute—very rapid attack, H_2SO_4 conc.—blackening of the surface. H_2O_2 100 vol. —violent attack with effervescence.

Polianite occurs in spherolitic form. Fine aggregates associated with certain granular constituents are developed inside the spherolites. It is very strongly anisotropic. The R.P. has been determined by a similar procedure using different filters (Wratten No. 29F, and No. 90) and also by a gas-filled potassium cell sensitive to blue. The standard mineral taken is silicium 99%, whose R.P. is very close to that of these manganese minerals. The following results were obtained:—

Wavelength	R'_g	R'_p	$(R'_g - R'_p)$
4600 Å ..	0·432	0·374	0·058
5700 Å ..	0·385	0·359	0·026
6500 Å ..	0·383	0·348	0·035

The result shows that the R.P. of the mineral varies with the wave-length of light, the higher R.P. being more dispersed. The mineral has got normal dispersion. The results of the etch tests are:—

Positive: HCl 1:1 dilute—after five minutes, blackening of the surface (Diff. between polianite and psilomelane)
HCl conc., H_2SO_4 conc.,
H_2O_2 100 vol., $FeCl_3$ 20%, $SnCl_2$.

Negative: KCN, KOH, $HgCl_2$, and aqua regia.

Romanéchite.—Very fine needles of this mineral are found to be formed in the veinules produced in psilomelane. The R.P. determined by the same cell for λ 6500Å is

$$R'_g = 0{\cdot}290 \quad R'_p = 0{\cdot}261.$$

The results of etch tests are:—

Negative: HCl dilute 1: 1, HCl conc., $FeCl_3$ 20%, H_2O_2 100 vol.

Positive: $SnCl_2$ saturated, H_2SO_4 conc., H_2SO_4 + H_2O_2.

Hollandite is found to be crystallized side by side with romanéchite. It occurs in grains often associated with polianite, and psilomelane. Its R.P. is inferior to that of polianite. Using the same method the reflecting power has been found to be:—

$$R'_g = 0{\cdot}329, \; R'_p = 0{\cdot}305.$$

The results of the etch tests are:—

Negative: HCl 1:1, HCl conc., HNO_3, KOH, KCN, $FeCl_3$ 20%.

Positive: H_2SO_4 conc., (slight attack), $SnCl_2$ saturated, H_2O_2 100 vol., H_2SO_4 + H_2O_2.

It is quite possible that these two minerals—romanéchite and hollandite—have been formed out of psilomelane, some of which has been dissolved and enriched afterwards by the addition of iron and barium. An excess of iron leads to the crystallization of hollandite, while its deficiency is responsible for the formation of romanéchite. Hollandite is a mineral which is known to be formed in the meso-zone of metamorphism; the microscopic study of this ore shows that it can also occur in the superficial sedimentary zone, in the lateritic rocks. It is evident from this study that romanéchite and hollandite are two distinctly different species. The reflecting power of hollandite is much greater than that of romanéchite. This fact can be further substantiated by the chemical composition, the etch test, and the

structural characters which are different in these two minerals.

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May 24, 1939.

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Orcel, J., "La mesure du pouvoir reflecteur des minéraux opaques à l'aide de la cellule photoélectrique et ses applications," *Bull. Soc. Fr. de Minéralogie*, 1930, t. 53, 301–49.

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Lethality of Gametes Conditioned by Exchange of Segments between Partially Homologous Chromosomes in a *Nicotiana* Species Hybrid

In studying the percentage of viable pollen in the species hybrid *N. glauca* × *N. Langsdorffii*, I found that their percentage corresponds approximately to the percentage of dyad and monad microspores formed in the hybrid as a result of non-occurrence of the first or of both meiotic divisions.[1] Studying the viability of the pollen in the species hybrid *Nicotiana Raimondii* ($n = 12$) × *N. tabacum* var. *Tyk-kulak* ($n = 24$) in connection with the dyad formation and the chromosome conjucation during the meiosis, quite different results were obtained. This hybrid, growing in the green-house, usually formed at the end of April (1939) 3–6 bivalents. Pollen-mother cells with 2 bivalents and with more than 6 were rarely found (ca. 6%). At the same time, in about 12–15% of the PMC dyad microspores were found. They usually resulted from non-occurrence of the first meiotic division (i.e., restitution nuclei). When the flowers opened and the anthers dehisced no viable pollen were found. This indicates that both kinds of pollen grains: (1) those having reduced nuclei, as well as (2) those having non-reduced nuclei (dyads) with the total chromatine material from *N. Raimondii* and *N. tabacum* (36 chromosomes), were lethal. The lethality of the first kind of pollen originating from reduced microspores has been usually interpreted in assuming irregular distribution of the hereditary material during the meiosis and formation of tetrad microspore nuclei with incomplete and unbalanced genoms. The pollen originating from dyad microspores have two complete genoms, the whole *Raimondii* genom and the whole *tabacum* genom, nevertheless they were lethal. Non-viability of these pollen-grains is not due to loss of some chromosome fragments as a result of crossing over in inverted region or regions, because one chromatine bridge was very rarely observed (in 0·3% of the pollen-mother cells), during the meiosis. The most probable cause for their lethality is the exchange of segments between partially homologous chromosomes which takes place in each pollen-mother cell between 3–6 partially homologous chromosome pairs (bivalents) following chiasma formation. The reliability of this assumption is supported by the behaviour of the same hybrid plants during the autumn (1938) when their meiosis proceeded at a lower temperature. At this condition the hybrid usually formed 0–4 bivalents, and had in about 18% of the pollen-mother cells (PMC) dyad microspores; ca. 5% of the PMC having asyndesis (no bivalents). They formed then about 0·4% viable pollen grains. These pollen grains probably developed from PMC with asyndesis, in which the first meiosis has failed, thus producing dyad microspores and further pollen with whole chromosome sets and unchanged chromosomes of the parental species *N. Raimondii* and *N. tabacum*. It should be mentioned here that these two species are not closely related. They belong to two different sections —the former to *Rustica* section and the latter to *Tabacum* section.

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Moscow,
May 18, 1939.

[1] Kostoff, D., *Journ. Genetics*, 1938, 37, 120–209.

A Note on the Embryo-Sac and Endosperm-Haustoria in Some Members of Scrophularineæ

A FEW contributions were made by the author dealing with the development of endosperm haustoria in *Sopubia delphinifolia*,[4] *Alonsoa* sp.,[4] *Isoplexis canariensis*[5] and *Celsia coromandeliana*,[5] *Limnophila heterophylla*[6] and *Stemodia viscosa*.[6] The author has described several interesting structural variations in the haustorial cells in the above members. The structure of the embryo-sac and the development of endosperm haustoria in *Vandellia hirsuta*, Ham., *V. scabra*, Benth., *Rhamphicarpa longiflora*, Benth., *Centranthera hispida*, Br., and *Sopubia trifida*, Ham., have also been studied in all aspects, and papers dealing with the same will be published elsewhere. A brief account of some of the members is given below.

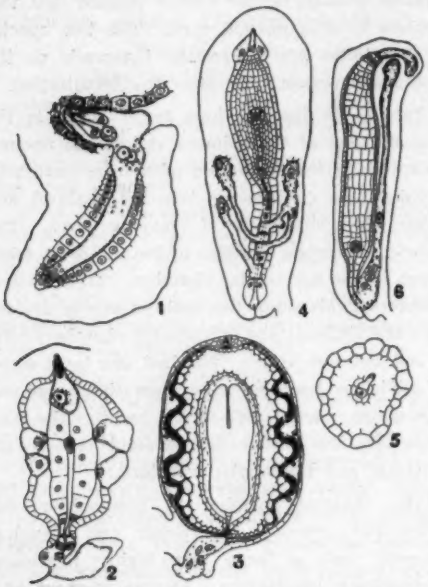
The presence of a reduced nucellus and a thick integument seems to be a constant feature. The eight nucleate intra-ovular embryo-sac is usually dilated towards the micropyle, and the egg apparatus is present in this part. *Vandellia hirsuta* (Fig. 1) forms an exception to this. Here the highly enlarged extra-micropylar part of the embryo-sac will be pressing against the placental and funicular epidermis from which nutrition is directly absorbed. A similar development of the sac is reported by Kausik[3] in *Utricularia cœrulea* and by Junell[2] in *Avicennia* and other members. The two polar nuclei are present in the middle of the sac, and the lower part is tubular and tapering towards the chalaza including three small antipodals. *Stemodia viscosa* is rather peculiar in having the chalazal part of the sac enlarged and the micropylar part tapering. Large antipodals and innumerable starch grains are present in this enlarged part, suggesting that this end probably takes part in the absorption of nutritive material from the integument before the chalazal haustorium is actually laid down. In all these plants the integumentary tapetum surrounds the non-dilated part of the sac and shows varying degrees of development.

In most cases observed till now the polar nuclei fuse to form the secondary nucleus just before fertilization. The several stages in fertilization studied by the author suggest that this process is of a normal type. The two species of *Vandellia* are interesting inasmuch as the antipodals persist long after the fertilization.

Just as in the previous forms there is the first division of the primary endosperm nucleus followed by the formation of a transverse wall dividing the embryo-sac into the chalazal and micropylar chambers of varying sizes. The second transverse division of the sac often takes place in the micropylar chamber. Thus by two transverse divisions the embryo-sac is divided into the chalazal and micropylar chambers with a cell between them. The last one by a series of divisions becomes endosperm tissue and accumulates plenty of starch, while the two chambers by further development become the chalazal and micropylar haustoria.

The chalazal chamber in *Limnophila*[6] and *Stemodia*[6] remains undivided and develops directly into a large and highly aggressive uninucleate haustorium. Generally there is a longitudinal division of this chamber and two uninucleate haustorial cells are organised. In the two species of *Vandellia* (Fig. 2) and in *Rhamphicarpa* (Fig. 6) a single binucleate haustorium results by the early fusion of these two uninucleate cells. The haustorium in *Vandellia* (Fig. 2) shows a decided tendency to become a uninucleate body, often by the degeneration of one of its nuclei and at times by the absence of a nuclear division. The chalazal haustorium in *Centranthera* (Fig. 5) is reduced in size and seems to be an almost nonfunctional body, while in *Rhamphicarpa*, *Limnophila* and *Stemodia* this happens to be highly enlarged and aggressive in nature. The mature chalazal haustorium in *Vandellia* shows cellulose rods whose disappearance during the haustorial degeneration forms a very interesting feature. Although Schmid[8] attributes a mechanical role to these rods, their disappearance in *Vandellia* is more in favour of the idea of a nutritional rôle. The older haustoria are

characterised by the presence of hypertrophied amœboid nuclei and darkly stained cell-contents.



1. *Vandellia hirsuta.*—Longitudinal section of the ovule showing the extra-ovular embryo-sac, tapetum and other parts of the ovule. × 240.
2. *Vandellia hirsuta.*—The two kinds of haustoria, tapetum and endosperm. × 13.25.
3. *Vandellia hirsuta.*—Longitudinal section of a nearly mature seed showing the haustoria, endosperm embryo and the peculiar tapetum. × 58·75.
4. *Centranthera hispida.*—Development of the endosperm and the formation of the haustoria. × 80.
5. *Centranthera hispida.*—Transverse section of the ovule showing the formation of the secondary endosperm haustoria. × 80.
6. *Rhamphicarpa longiflora.*—Formation of the endosperm and the two kinds of haustoria. × 48.75.

Often two longitudinal divisions take place in the micropylar chamber although in some members like *Centranthera* and *Gratiola officinalis*[1] only one may be present. At times even the single divisional wall may be incomplete as is reported in *Paulownia tomentosa*.[7] Thus the two longitudinal divisions result in the formation of four uninucleate haustorial cells which fuse at a later stage to form a tetranucleate body (Figs. 2 and 6). In *Vandellia hirsuta* and *V. scabra* this does not enlarge much. In *Rhamphicarpa* (Fig. 6) this tetranucleate body forms a branching aggressive haustorium with the hypertrophied nuclei placed in the tube-like branches which eat their way into the integument and approach the chalazal haustorial tube. At times the two haustoria communicate with each other by the disorganisation of the intervening tissue. *Centranthera* (Figs. 4 and 5) seems to be remarkable in showing the formation of secondary haustoria since the first formed micropylar haustorial cells also appear to be almost nonfunctional. In this plant some of the endospermal tiers connecting the micropylar haustorium with the deeply placed endosperm tissue send out haustorial tubes into the integument and absorb nutrition by disorganising its cells (Fig. 5). Thus the delay in the organisation of endosperm proper in *Centranthera* may be attributed to the peculiarity in the haustorial formation.

The haustoria in *Vandellia* and *Centranthera* seem to be inadequate to meet the nutritional demands of the growing endosperm and embryo. In these members the tapetum comes in very handy. Some of the cells of the persistent tapetum enlarge in a significant manner (Figs. 2–4) and take part not only in the digestion and absorption of the tissue contents of the integument but also in the storage of the same and their transportation to the developing endosperm later on. The distribution of these cells along the tapetal sheath appears to be irregular in the two species of *Vandellia*, while in *Centranthera* these are confined to the chalazal end of the sheath. Just as in *Celsia* the tapetum in *Vandellia* shows its inner wall highly thickened, which forms thus a probable device for the protective rôle.

I wish to thank Dr. M. A. Sampathkumaran, M.A., PH.D., Professor of Botany, Central

College, Bangalore, who was kind enough to give me all facilities for this work.

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[1] Glisic, Lj., *Bull. Inst. Jard. Bot. Univ.*, Beograd, 1933, Tom **2**, No. 3, 129–52.

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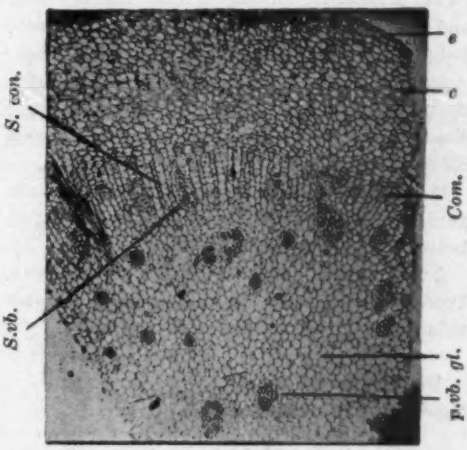
Secondary Growth in the Bulb of *Polyanthes tuberosa* L.

Polyanthes tuberosa L. (Amaryllidaceæ, according to Engler and Hutchinson), a native of Central America, Trinidad, is now fairly common as a garden plant in India. The bulb of this plant shows secondary growth like that found in the aerial stems of *Dracæna*. Both the primary and the secondary vascular bundles are collateral in the bulb of *Polyanthes*, while they are concentric in the aerial stems of *Dracæna*. Pfeiffer[2] in 1926 recorded that the underground stem of *Polyanthes tuberosa* is homologous with the aerial stem of *Dracæna* in the matter of secondary growth. In such monocotyledonous stems with sufficient secondary growth, it becomes somewhat difficult to distinguish the secondary tissues from the primary ones. But this difficulty can be easily overcome by the following diagnostic characters of Röseller as cited by Cheadle[1]:—(1) the paucity of phlœm elements in the secondary bundles, (2) the oval shape of the secondary bundles, (3) the more or less radial placement of these bundles, and (4) the radial orientation of the conjunctive tissue. In addition, Cheadle[1] holds that the short sieve-tubes and the lack of spiral or annular elements in the secondary bundles are valuable criteria.

Small pieces of young bulb of *Polyanthes tuberosa* L. were fixed in "Craf" overnight, according to Randolph[3] and directly taken to 75% alcohol, and after changing three or four times the usual processes of dehydration and infiltration were followed. Serial microtome sections 6 to 10 μ thick were cut transversely from the growing point of the stem to its base and the sections of the younger part were stained in Delafield's hæmatoxylin only, while those from the older parts were stained in safranin and Delafield's hæmatoxylin. On examining sections from the tip, protected by crowded leaves with axillary rudimentary buds, young primary vascular bundles were found scattered in the ground tissue a little lower down. When the sections of comparatively older part away from the tip are examined, the primary growth is found to be complete and very soon secondary elements begin to develop from a distinct ring of cambium (Fig. 1). On cutting sections 10 to 15 μ thick from older



e.–epidermis; *c.*–cortex; *cam.*–cambium ring; *s.vb.*–young secondary vascular bundle; *s.con.*–secondary conjunctive tissue separating the secondary vascular bundles; *gt.*–central ground tissue with scattered primary vascular bundles (p.vb.); *p.vb.*–primary vascular bundle.
(Photomicrograph—Eyepiece 15 × and Obj. 40 mm, apochromat.)

bulbs by freezing microtome and staining them in safranin and Delafield's hæmatoxylin the secondary vascular bundles in all stages of development are found prominently separated from each other laterally by the radially elongated secondary conjunctive tissue; these sections show clear secondary growth with superficial periderm and cork cambium, though in the younger bulb (Fig. 1), the periderm and the cork cambium are both absent. In *Dracæna* stem Strasburger[4] (Fig. 44) also clearly demarcated the secondary conjunctive tissues with radially elongated cells from the rest of the central polygonal cells of the primary ground tissue.

Secondary growth in Monocot. stem with the help of permanent cambium has been observed in stems of local *Curculigo recurvata* (Amaryllidaceæ) and *Sansevieria zeylanica* (Hæmodoraceæ) as recorded by Pfeiffer[2] and Cheadle.[1] Thus, the total number of Monocot. plants, so far investigated, which show secondary growth by permanent cambium, belongs to about 19 genera, *viz.*, *Aloe*, *Cordyline*, *Dasylirion*, *Dracæna*, *Kniphofia*, *Nolina*, *Yucca*, *Xanthorrhœa* and *Veratrum* (Liliaceæ), *Agave*, *Furcrœax*, *Polyanthes* and *Curculigo* (Amaryllidaceæ); *Aristea* and related genera (Iridaceæ); *Testudinaria*, *Tamus* and *Dioscorea* (Dioscoreaceæ); *Sansevieria* (Hæmodoraceæ); and *Acorus calamus* (Araceæ).

Polyanthes tuberosa L., being a very common garden plant in India, the attention of Indian botanists is drawn to its anatomy.

I am greatly indebted to Dr. S. R. Bose, Professor of Botany of this College, for his valuable help and criticism in this work.

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Calcutta,
May 3, 1939.

[1] Cheadle, Vernon, I., "*Bot. Gaz.*, 1937, **98**, 535–55.
[2] Pfeiffer, H., *Handbuch der Pflanzenanatomie. K. Linsbauer*, **Band IX**; *Das Abnorme Dickenwachstum*, Bremen, 1926.
[3] Randolph, L. F., *Stain Tech.*, 1935, **10**, 95.
[4] Strasburger, E., *Handbook of Practical Botany*, 1924, 8th Edition, Fig. 44, p. 118.

Loss of Water by Evaporation from the Upper Surfaces of Soil Columns Resting on a Water Table

It is well known that, if a layer of soil rests above a water table, moisture ascends upwards in the soil; the height up to which the moisture ascends as well as the rate of ascent depend upon the physical properties of the soil. The fact that the actual rise of moisture is much smaller than what one should expect according to the classical "capillary theory" has been pointed out by several writers.[1]

If the top of the soil column is freely exposed to the atmosphere, evaporation of moisture takes place, the evaporation depending partly upon the saturation deficit and velocity of the air layers immediately above the soil and partly upon the rate of arrival of moisture at the soil surface from the lower layers.

To conduct preliminary experiments on some of the above phenomena with typical Indian soils, a soil evaporimeter with bottom feed was constructed locally. This consists of a metallic cylinder 5" in diameter containing soil and is kept with its perforated bottom in contact with water in a close fitting reservoir. Fig. 1

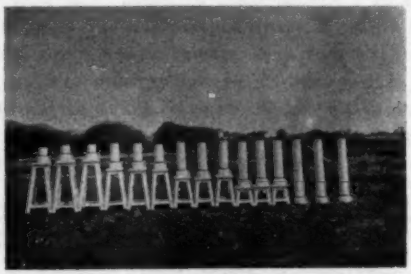

Fig. 1

shows a series of these evaporimeters in triplicate with soil columns 6", 1 ft., 1½ ft., 2 ft. and 3 ft. respectively in depth. The three instruments corresponding to each of the depths mentioned above, were filled with Poona soil (black-cotton), normal Punjab soil (alluvial) and "bari" (alkali) soil from the Punjab respectively. The packing of soil into the vertical cylinders was done uniformly. The evaporimeters were weighed daily at 8 a.m., replenished with water upto a reference mark on a side

tube of glass, and then weighed again. The difference between the weight after adding water of one day and the weight before adding water of the next day gives the actual loss of water by evaporation from the upper surface of the soil column. To ensure uniformity of exposure the series of soil evaporimeters was set up on suitable wooden platforms so that the tops of all the instruments were at the same level above ground.

The time taken by water to rise upto the top of the different soil columns in the different soils (this is indicated by the appearance of wetness at the surface and also verified from the daily evaporation losses) is given in Table I below.

Punjab soils the wetting of the soil at the surface does occur even when the subsoil water level is 3 ft. In "Bari" soil from the Punjab, however, water is unable to ascend beyond 6 inches even after the lapse of several months.

The actual loss of moisture may now be considered. The experiments with five different depths of each of the three soil types were started on the 5th December 1938. The data for the month of December need not be considered as it takes some time for a steady state to be attained. The mean daily evaporation in inches, during January, February and March 1939, as well as the mean daily evaporation in inches from a Piche evaporimeter kept at 4 ft. above ground are given in Table II.

TABLE I

Type of soil	Height of soil column				
	6 in.	1 ft.	1½ ft.	2 ft.	3 ft.
Poona soil	1 day	2 days	6 days	15 days	Not wet even after 3 months
Punjab soil (normal) ..	1½ days	3 ,,	5 ,,	10 ,,	21 days
"Bari" (alkali) soil from the Punjab	3 ,,	Not wet even after three months			

TABLE II

Month	Type of soil	Mean daily evaporation in inches from the top of soil columns with depths of					Piche evaporimeter 4 ft. above ground
		6 in.	1 ft.	1½ ft.	2 ft.	3 ft.	
January 1939	Poona soil	·30	·27	·18	·12	·01	·45
	"Bari" soil from Punjab ..	·05	·02	·02	·01	·01	
	Punjab soil (normal)	·29	·23	·21	·18	·09	
February 1939	Poona soil	·38	·34	·22	·15	·02	·56
	"Bari" soil from Punjab ..	·06	·02	·02	·02	·01	
	Punjab soil (normal)	·37	·26	·22	·18	·09	
March 1939	Poona soil	·48	·41	·23	·16	·02	·71
	"Bari" soil from Punjab ..	·05	·03	·03	·02	·01	
	Punjab soil (normal)	·43	·30	·21	·17	·08	

It is thus seen that in the case of Poona soil actual wetting at the soil surface does not take place even after the lapse of three months when the subsoil water level is more than 2 ft. below the surface. In the case of the normal

From Table II the following general conclusions may be drawn:—

(1)) The amount of water lost by evaporation decreases as the water table recedes below the surface; when the water table is 3 ft. below

the surface the loss of water is considerably smaller than when the water table is only 6" below the surface.

(2) Comparing the three soil types amongst themselves it is seen that the loss of water from "Bari" soil (alkali soil containing a large percentage of salts) is strikingly smaller than that from either the normal Punjab soil or the Poona soil for all the depths of the water table considered in these experiments.

(3) Comparing the alluvial soil from the Punjab and the black cotton soil of Poona it seems that the amount of water lost from both of these soils is of the same order of magnitude, with this difference, however, that when the depth of the water table is greater than 1½ ft., evaporation from the alluvial soil of Punjab (which is more porous) is somewhat more than from the black cotton soil of Poona (which has a larger clay-fraction and is less porous).

The experimental results will be discussed at greater length in a later publication.

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A. K. MALLIK.
India Meteorological Department,
Poona,
May 9, 1939.

[1] Keen, B. A., "The Physical Properties of the Soil," *The Rothamsted Monographs on Agricultural Science*, Chapter III, 1931.

Studies on the British *Aleurodidae*

THE British species of *Aleurodidae* have not received the due share at the hands of the entomologists in the past. Their comparative morphology and bionomics were not thoroughly studied and unfortunately their systematics were also left in the same unsatisfactory state. Even until recently the position of some of the British species was as undefined as before, since their descriptions could not afford positive diagnostic characters.

The original specific differentiations of the species under reference were based primarily on their food plants and such variable characters as the colour and shape of the body, the number of hairs on pupæ, or the relative proportion of the antennal segments. The subsequent workers, in most cases, reconciled with the original views without even doubting the possibility of variations in such characters or realising the significance of biological necessity for the extension of alternative food plants and their consequent influence on any of these characters.

The present investigations, therefore, were taken up at the Rothamsted Experimental Station, with the object of studying the available species, with regard to their systematics, food plants and habits, etc.

Since the differentiating features of the nature stated above were found to be of least specific value for classification purposes, attempts were made to establish more reliable differences on the basis of certain constant characters. As the vasiform orifice is quite specific to this family and is a constant organ in all the stages after the egg, and the gentilia has also yielded results of considerable interest in the taxonomy of other insects and is often used in determining species and genera, therefore, a thorough comparative study was made of both these characters along with others, and specific differences of significance were noted.

Of the nineteen species recorded in Britain, fifteen were studied during these investigations. Besides, two new species, namely, *Aleuroplatus kewensis* and *Trialeurodes williamsi* were described[1] from ferns in hot houses at Kew Gardens.

Four pairs of the species previously considered as different, namely, (1) *A. carpini* and *A. rubicola*, (2) *A. loniceræ* and *A. rubi*, (3) *A. proletella* and *A. brassicæ*, (4) *A. quercus* and *A. avellanæ*, have now been shown morphologically identical in all their stages, which are also described. Their identity has also been established by cross inoculations, as well as, by life-history studies. Moreover, a new genus *Asterobemisia* is proposed for the species in Set (1) and that under (4) is shifted to genus *Pealius* according to the characters of the pupa, and a new description is given for the adult of *P. quercus*,[2] because the previous one did not agree with this species.

Further, some significant differences are also shown for *S. phillyreæ* and *S. immaculata*, and certain differential characters have been pointed out for *T. sonchi* and *T. vaporariorum*. The immature and adult stages of *S. phillyreæ* are also described and some stages of *T. ericæ* and *D. chittendeni* are described for the first time.

Seasonal colour variations were also studied in the pupæ and adults of *A. loniceræ*, both in nature as well as in the laboratory, and at the same time some new alternative food plants were recorded in several species. It is therefore suggested that, such variable characters may not be regarded as conclusive when following any work of systematic nature in *Aleurodidæ*.

Parasites and parasitism were also studied in some species of British white-flies. Transfers of parasites from one species to the other, proved successful when those from *S. phillyreæ* and *T. vaporariorum* were bred on *A. proletella*.

Relative oviposition and the rate of development under coloured screens was studied in *A. proletella* and *T. vaporariorum* under laboratory conditions.

The results of all the above investigations are being compiled and will be published very shortly.

The assistance of Dr. C. B. Williams and the encouragement by the Indian Central Cotton Committee, by the grant of a foreign scholarship, are gratefully acknowledged.

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Agricultural College and
Research Institute,
Lyallpur,
February 2, 1939.

[1] Trehan, K. N., *Proc. R. Ent. Soc. Lond.*, (B), 1938, 7, 182.

[2] The genus proposed by the present author.

REVIEWS

The Properties of Glass. By George W. Morey. (Reinhold Publishing Corporation, New York; Chapman & Hall, Ltd., London), 1938. Pp. 561. Price $12·50.

Whoever has read Morey's recently published book, must have come to the conclusion that the international literature on glass has gained a work of fundamental importance. It fills a gap, as no book on glass physics, of this class, was available in English.

The Germans have the *Glastechnische Tabellen*; as the name indicates, it is meant more for reference than for continuous reading. In French appeared in the last few years, Long's excellent book and Damour's three volumes, dealing with physical properties of glass. Both go out from industrial and manufacturing problems, devoting much space to description of processes, the understanding of which is the main aim of the authors.

Morey's book is based on the conception of pure glass science, it avoids any discussion or description of technicalities of industrial glass making. It deals with the physics of glass only, and is in its kind the most exhaustive and complete work that has ever appeared on the bookshelves.

The author's thoroughness, his indisputable talent for clear arrangement of dry data and facts in a pleasant and readable way, his logical penetration into the respective merits of diverging theories, further his personal authority, allowing a general welding together of other people's work with his own research and experience, qualify the book not only as a mine of information, but also as an instrument for better understanding of intricate phenomena. It is the first attempt on a general synthesis of the science of glass and a successful one.

All chapters are equally good and in line with the character of the work. The definition of glass, its composition, devitrification, durability, viscosity, annealing, tension, heat capacity, density, expansion, thermal endurance, etc., etc., are their respective subjects. The critical and conversant reader will hardly find anything of importance omitted.

Technicians and industrialists will find the chapters most instructive and informative, the scientist will gain by the masterly co-ordination of knowledge; all will appreciate the art of accurate thinking.

Morey's *Properties of Glass* is a standard work and its appearance, a paramount literary event in the glass world since Dralle's first edition in the pre-War days.

A. NADEL.

Reports on Progress in Physics. Vol. V. (Published by the Physical Society, London), 1939. Pp. 445. Price 20*sh*.

This is the fifth of the series of reports on the Progress in Physics published by the Physical Society of London, under the editorship of Prof. Alan Ferguson. The aim of these reports according to the editor is "to present articles which shall discuss the latest developments in physical science, and which shall at once make clear to the non-specialists the meaning and extent of these advances, and provide the researcher in the particular field under discussion with a technical resumé helpful to him in his own work". The articles appearing in these reports are not so specialised or detailed as those appearing in the *Review of Modern Physics* or in the *Ergebnisse der Naturwissenschaften*. But within the prescribed limits, they are well written and very timely. The retiring editor of these reports Prof. Ferguson is to be congratulated on the success with which he has carried out his aim in the present volume.

The articles contained in the present issue are (i) reports on recent advances in different branches of Physics, and (ii) special articles on certain aspects of theoretical and experimental physics and on technical applications of physics, which have come into prominence recently. It is not possible for the writer to review adequately all the

articles which appear in this Report. Mention is made below of some of the articles which have been of interest to him.

Mott and Gurney give a useful summary of certain theories of the liquid state which are based upon the assumption that a liquid is a broken up or disordered solid. The report on the soft X-ray spectroscopy of the solid state by H. W. B. Skinner is of great interest, as such investigation enables the electron level characteristic of a given solid to be determined. The article by W. V. Mayneord 'On the use of X-rays and γ-rays in medicine' is very timely in view of the rapid advance in the technique of high voltage generation and its application to the production of penetrating X-rays.

Users of Geiger counter tubes will find an article on the subject by A. Nunn May very helpful. The article by F. C. Champion "On the single scattering by elementary particles", specially by neutrons and protons is of interest in view of the information they give about nuclear binding forces. Some recent developments in Quantum Mechanics and the difficulties associated with the first order equation of Dirac are reviewed by H. T. Flint.

Of special interest to students of Cosmic rays is a very well-written report on the subject by W. Heitler, who has himself contributed largely to our understanding of the effects produced by the soft components of the Cosmic radiation. The reviewer has found it to be a very good introduction to a rather difficult and complex branch of investigation.

Among articles reviewing recent technical applications of Physics mention may be made of the following: 'Plastics in industrial physics' by H. W. Melville, 'Instrumental aids for defective hearing' by Phyllis Kerridge, 'Television optics' by W. D. Wright and 'Electric wave filters' by N. F. Astbury.

During the last few years there has been a rapid advance in the teaching of science in schools and intermediate colleges in this country. Those who are responsible for the introduction of such courses and also for physics teaching will be specially interested in the last article in this volume 'On the teaching of physics in schools' by A. W. Barton. The reviewer has read the article with great interest and profit.

D. M. Bose.

American Medicine (Expert Testimony Out of Court). Vols. I & II. (The American Foundation, 565, Fifth Avenue, New York), 1937. Pp. 1,435.

These two sumptuous volumes forming the study of the American Foundation, are devoted to the consideration whether government should or should not play an increasing part in the administration of public activities in the organization of medical care. The Medical Advisory Committee associated with the Foundation Studies issued a comprehensive questionnaire to their colleagues, and the replies received constitute the text of the two volumes. There is no department of medical enquiry which has not been adequately covered by the replies, and there must be general agreement about the usefulness of making the report available for the professional men and the public. It would not be correct to describe the books as a compilation of opinions, valuable as they are, but they hold within their compass many useful and significant facts, not of the usual statistical importance, but of the kind derived from realized experience. The whole object of the two volumes is to illuminate the several issues involved in the questionnaire, and not to prove any pet doctrine; and the replies therefore deal with problems capable of being handled experimentally by all the resources of science and statesmanship. The letters on which the volumes are based are about 5,000 from approximately 2,100 medical men. This stupendous mass of correspondence is, however, so analytically arranged under suitable heads, that the reader can easily find collected under his favourite topic a wide body of intelligent information. At first sight the two volumes might seem formidable even to a voracious appetite, but once the reader plunges into the study, the interest he develops will carry him safely through the 1,290 pages, the matter provided being calculated to stimulate rather than to cloy his keenness.

A store of information of such magnitude and importance cannot fail to invoke the interest of the professional medical men and practical statesmen charged with the duty of organising the welfare and medical care of the public. This work of reference has a permanent value. We hope that it will be widely welcomed and appreciated.

Medical Entomology (A survey of Insects and Allied Forms which affect the Health of Man and Animals). By William A. Riley and Oskar A. Johannsen. Second Edition. (McGraw-Hill Publishing Co., Ltd., London), 1938. Pp. xiii + 438, Price 25/-.

The second edition of this book which has incorporated all the latest advances obtained from the laboratory investigations and field researches, provides a complete and competent knowledge of one of the important depertments of medical science. Insects and parasitic arachnids, having victimised the precursors of man, have been tormenting him since his appearance on this planet, and the war against them, with all the resources which science has placed at his disposal, has not ended and probably may not end. This warfare is full of romantic episodes and human interest. Apart from the professional importance usually attached to a book on Medical Entomology, the interest it holds for the well-being and economic efficiency of the community should be sufficient inducement for the general public to become acquainted with the fundamental principles of this fascinating branch of science.

Students of medicine will find in this book a full and competent exposition of the subject of transmission of diseases by insects and other allied members, together with a complete account of the measures to control their dangerous increase menacing the spread of dire scourges. Municipal commissioners will discover a store of valuable information indispensable for dealing promptly and satisfactorily with the problems of public sanitation and general hygiene. Health Officers will welcome this book as a faithful companion in their efforts to control epidemics, and Ministers of Public Health fortified by an intimate knowledge of the latest developments in the science of medical entomology, would be able to formulate wise and far-reaching policies ensuring the health and diminishing the incidence of disease in the body politic.

This deeply interesting and stimulating book written with considerable insight and knowledge, should appeal to professional men and the ever-widening circle of intelligent readers who wish for an enlightened attitude to all that pertains to a healthy and prosperous human existence.

Any scientific work must necessarily include large sections on systematic and anatomical studies, but the chief merit of the treatment of these topics as presented by the authors is that instead of scaring away the general reader, it provides added interest to his understanding. The life-histories of insects are told in simple language and the numerous illustrations which are clear and attractive will enable the lay readers to obtain a vivid picture of the whole developmental process of the group. The chief importance of the subject of entomology lies in the fact how the insects which must have entered at first into symbiotic relations with the warm-blooded animals, gradually changed this phase of biological phenomenon into parasitic habits, with dreadful consequences to the hosts. Perhaps recruitment to the ranks of parasitism is silently taking place at present in order to restore the balance of power in their conflict with man who is their only implacable enemy. The fact that Nature, while destroying the gigantic lizards and mammals, has carefully preserved the flea, the louse, the bug and the cockroach, shows that the power to survive cataclysmic changes on the part of insects is infinitely greater and more varied than in the highly specialised creatures, and the laurels of the fight will necessarily go to the party more favourably endowed. At present man seems to be engaged in an unequal contest, but later on when his knowledge and resources become fuller he may deal a death-blow at the vermin pestering him, and before he does so, he must have a deeper understanding of the consequences resulting from the extinction of his enemies.

Those who wish for more information than is contained in the book are referred to an extensive Bibliography provided in the Appendix, and others who may wish to have a ready weapon to deal with the household pests have a chemical formula indicated, with directions fumigating them.

The book is a welcome contribution to the science of Medical Entomology. It is bound to be widely appreciated.

Electrical Engineering Practice. By J. W. Meares and R. E. Neale. Vol. I (5th Edition). (Chapman & Hall, Ltd., London), 1938. Pp. 780. Price 25*sh*.

The fifth edition of this very useful book will be equally welcome to the engineer and the student of modern electrical practice. It treats the subject simply but exhaustively and no important advance in equipment or

practice seems to have been omitted. In the present edition the book has been thoroughly revised and considerably enlarged by the addition of a lot of new up-to-date matter. It aims at filling a gap between pocket books containing technical data and technical works by specialists dealing with individual branches of electrical engineering, the book deals not only with a mass of useful technical data and information relating to modern methods but also with simple and clear explanations relating to electrical phenomena and theory. Yet throughout it is essentially practical in tone and contains information of a strictly utilitarian nature. It will thus be useful not only to the electrical engineer but also to the civil or mechanical engineer who has anything to do with electrical engineering. The Bibliography at the end of each chapter adds considerably to the value of the book and makes it a useful work of reference which should find a place in the library of every engineer. That it fills a real want can be seen from the fact that it has now run into the fifth edition.

F. N. M.

The Commissioning of Electrical Plant and Associated Problems. By R. C. H. Richardson. (Chapman & Hall, Ltd., London), 1939. Pp. 380, 201 figures. Price 21*sh.* net.

Many readers of this book will find the "associated problems" of more interest than the main subject of the title. It is divided into sections dealing with the main types of electrical plant: the first part of each section deals with the commissioning of the particular type and this is followed by chapters on troubles in that type, peration, and "theoretical and practical considerations relative to running".

The "Commissioning" part is a very complete and up-to-date collection of information, instructions and points to be taken care of, while the remainder of the book deals with a variety of interesting problems which is not usually found between the covers of one book and it is a valuable addition to the literature on electrical engineering. Power engineers will find the whole of the book of direct application to their work, while students will find in it a collection of problems which will be directly useful to their studies, such as neutral point earthing, parallel operation of transformers, calculation of short-circuit currents, measurement of power factor, etc. The last chapter contains useful "technical methods", for those whose mathematics is not too strong, on such matters as Symmetrical Components.

The whole book is well written in a concise manner, right up-to-date and includes many points not previously covered in text-books.

It is easy to read by anyone with even elementary ideas of electrical engineering and requires only a limited knowledge of mathematics.

K. ASTON.

Chemistry of Proteins. By Dorothy Jordan Lloyd and Agnes Shore. Second Edition. (J. A. Churchill, Ltd., London), 1938. Pp. xi + 532. Price 21*sh.*

Since 1926, when the first edition of this volume made its appearance spectacular advances have been made in the field of protein chemistry. The Carbobenzoxy method of Bergmann, which has revolutionised the synthesis of peptides, has led to the elucidation of the nature of proteoclastic action on the one hand and of protein structure on the other. Advances in immuno-chemistry and nutrition, crystallisation of proteoclastic enzymes and plant viruses, X-ray studies of proteinous fibres, ultracentrifugal studies of these high molecular compounds at Upsala, have all wielded a tremendous influence on the progress of protein chemistry and these represent studies which have been made since the publication of the first volume. A second edition of the volume has, therefore, not appeared a little too early, and has appeared as a collaborative effort. The incorporation of these developments has necessitated the omission of the industrial aspects of protein chemistry, which were featured in the first edition. We have no doubt that the authors will plan the publication of a companion volume devoted to a discussion of the applied aspects of the subject.

The task of weaving together the advances in such apparently diverse fields, from enzyme chemistry to X-ray analysis, has been admirably accomplished by the authors and we have in this volume a well-knit account of the chemistry of proteins clearly presented and critically appraised. This is a volume which should have wide appeal to a large circle of investigators, physicists, chemists, physiologists and biochemists all of whom will warmly welcome the appearance of a well-informed text-book on protein chemistry in the English language.

M. S.

The Origin of Life. By A. I. Oparin. (Messrs. Macmillan & Co., Ltd., London), 1938. Pp. 270. Price 8/6.

An extremely fascinating book which seeks to give a physico-chemical explanation for the origin of life. All theories in support of the spontaneous generation of life are briefly stated and dismissed as fantastic. The conditions on earth when it separated out from the Sun were such as to make existence of life impossible. It is logical to presume that the manifestation of life has taken place during the evolution of matter. Carbon, nitrogen and other elements present in the Sun passed into the gaseous matter which ultimately condensed to form the earth, and in the process of cooling down, produced carbides and nitrides of heavy metals. The interaction of these substances with the aqueous vapour present in the atmosphere, gave rise to hydrocarbons and ammonia and from these arose a variety of organic substances which became progressively complex through polymerizations and condensations. These complexes were held in colloidal suspension in the water of the seas. As the colloidal suspensions of different substances came together, new forms, the coazervates, resulted which got separated from the aqueous medium. The coazervates developed within themselves definite physico-chemical structures and their further history depended upon their ability to incorporate into themselves the organic substances present in the medium, or in other words, their ability to grow. A dynamic condition was thus established and only such coazervates survived which developed a favourable internal organization. The 'life' so begun started on its course of evolution.

The coazervate thus becomes the pattern of life and occupies the central position; in fact, it lies between the living and the non-living. At a later stage, it acquired such attributes as adaptation, movement, metabolism, reproduction, which are generally associated with life.

That the origin of life must be capable of explanation from pure physico-chemical considerations is an article of faith with the scientist. Just as the once insurmountable barrier between inorganic and organic matter vanished with the synthesis of urea by Wöhler, even so, the transformation of non-living matter to living substance capable of exhibiting directive and self-duplicating powers may become capable of rigorous proof. The question is, how far has such a proof been furnished? In his review on *The Laws of Heredity and the Cause of Evolution*, Dr. MacBride (*Science Progress*, 1939, 33, 773) refers to a reply which Sir James Jeans gave when he was "chided" for using the word "creation". The reply was "It is all very well, science takes you back a certain distance and then brings you up against a blank wall". We admit that Prof. Oparin has taken the wall to a greater distance than ever before but it is doubtful whether the wall has been demolished. The origin of organic matter, of colloids and of coazervates has received plausible explanation but while one is in full accord with Prof. Oparin in the possibility of Coazervates developing structures and even undergoing duplication, it would be pertinent to ask whether such capacity distinguishes the living from non-living matter? Traube's 'artificial cells' too have structures and exhibit the phenomena of growth and multiplication. To say that with the coazervates "a peculiar selective process had come into play which finally resulted in the origin of colloidal systems with a highly developed physico-chemical organization, namely, the simplest primary organism", is to import into the discussion a factor which is obscure. The processes that were responsible for endowing the colloidal complexes with the attributes of life, i.e., "purposefulness in the development of the inner structure adapted to carry on definite vital functions", remain yet undefined.

The book constitutes a distinct contribution to the existing literature on the origin of life. The translator has earned the gratitude of the English-knowing public for making Prof. Oparin's thesis accessible to them.

Portraits of Eminent Mathematicians. Portfolio II. By David Eugene Smith (Scripta Mathematica, New York), 1938. 13 Portraits. Price $3.

This portfolio, the second in the series, contains the portraits and brief biographical sketches of thirteen eminent mathematicians, whose contributions to the science of mathematics are of a permanent character. It includes such distinguished names as Euclid of Alexandria, unique as a text-book writer; Cardan (1501–1576), the foremost Italian mathematician, a genius without principles;

Kepler (1571–1630), the brilliant astronomer, dogged by illness and poverty, who became the Professor of Astronomy and Mathematics at Graz at the age of 23; Fermat (1608–1665), a most retiring man of science who gave no attention to mathematics until he was over 30 years of age; Pascal (1623–1662), whose life was brief but brilliant, a man of delicate health, who had "never passed a day without pain from the age of 18"; Euler (1703–1783), who could calculate without effort "as men breath and eagles sustain themselves in the air" and though handicapped by the loss of his right eye at the age of 28 and his left eye at 59, continued his studies with the assistance of his son; Laplace (1749–1827), famous for his efforts to educate the educators, to raise teachers to the rank of scholars; Cauchy (1789–1867), the conceited mathematician, born poor but achieved success in later life, the author of about 800 important *memoirs*; Jacobi (1804–1851), a German scholar well known for his work on Elliptic Functions; Hamilton (1805–1865), the Irish infant prodigy, who could read English fluently at 3, perform mental long operations with numbers at 12, and was looked upon as an outstanding scholar of international standing at the age of 17, well known for his work on Quaternions; Cayley (1821–1895), the English mountaineer-mathematician, who spent a good deal of his time in reading novels and published 967 papers; Chebishef (1821–1894), one of the two greatest mathematicians of Russia, generally looked upon as the founder of the Russian school of mathematics, who chose a life of struggle and poverty in order to continue his mathematical career and lastly Poincaré (1854–1912), with feable eyesight but remarkable memory, with no remarkable ability for mathematics as a youth, but grew up into one of the greatest mathematicians of all times. These are scientists whose biographies are briefly recorded in the portfolio. "You may think", says the author in his Introduction, "that if you only had a fortune, if you had been born in luxury, and if you 'only had a chance' in this world, your name might be known in every city, State and country. A study of the lives of those who became known as leaders in the fields of mathematics, natural science, engineering and their related subjects, will show you that great renown may be achieved by those of humble birth and seemingly hopeless 'chance'." How true these words are can be realised by a study of the biographies recorded in this valuable work.

Wood Pulp. By Julius Grant. (Chronica Botanica Co., Leiden), 1938. Pp. 209. Price 15*sh.*

The above work, which has been published by Chronica Botanica Co., Leiden, Holland, as Vol. II of *A New Series of Plant Science Books*, presents in a fascinating and realistic manner the complete story of wood pulp, on which industries of great economic importance and vast magnitude, *e.g.*, paper and rayon, are based and which is the parent substance for a number of other promising industries, *e.g.*, power alcohol, sugars, explosives, plastics, constructional materials and so on.

In the first chapter of the book, the author prepares the ground by giving a general introduction to the definition and nature of wood pulp and its relationship to other fibrous materials, the geographical distribution and conservation of 'Wood Pulp Forests' (this might have been better put as 'Pulp Wood Forests') and the classification of pulp woods. After giving a historical survey of Paper-making and Manufacture of Wood Pulp in the second chapter, the author leads the reader on, in the third chapter, to a brief account of the chemical properties, compounds and structure of cellulose and of the structures of fibres and the growth of trees. In conformity with the purpose of the series to which the book belongs, a reference is then made in the fourth chapter to the anatomical, physical and chemical methods of identifying and evaluating pulp woods. With this foundation the author proceeds, in the next seven chapters, to give essential details, involved in the manufacture of mechanical and chemical pulps from wood. Without going into too many technical and engineering details, the author lucidly and briefly explains the theory and practice of the principal established processes, *viz.*, (1) the mechanical or groundwood process, (2) the sulphite process and (3) the alkaline process (soda and sulphate processes) together with the chemistry and methods of recovering alkali from these processes. No mention, however, is made of the neutral sodium sulphite process, perhaps because this process has hitherto found only a limited

application. The nature and properties of pulps obtained by each process and the uses to which they are put are discussed along with each process. The next three chapters deal with the chemistry and modern practice of bleaching, purifying and refining the pulps. In the following chapter an interesting account is given of the work done on the possible utilisation of the various by-products arising from the operations of pulp manufacture by the three main processes. Physical and chemical tests for the evaluation of pulps for paper, rayon and similar purposes and identification of fibres are embodied in a brief but clear manner in the next two chapters. The next chapter deals with the processes employed in the conversion of pulp into paper and boards. The first half of the next chapter summarises the type of paper for the manufacture of which the various grades of wood pulp are available and the processing of papers for the manufacture of speciality products, *e.g.*, chromo and art papers, vegetable parchment, vulcanised goods, waxed and waterproof papers, cheque papers, photographic papers, and so on. The next half of the chapter deals with the production of rayon and allied products, *e.g.*, staple fibres, dopes, lacquers, plastics, explosives, photographic films, etc. In the last chapter the author addresses himself briefly to a consideration of the numerous other miscellaneous uses to which wood pulp has been put in recent times, *e.g.*, moulded products, constructional and building boards and materials, toilet requisites, imitation leather, pulp yarns, textile products like "cellwolle", cellulose sponges and so on. The book is concluded with an interesting discussion on the future supplies of pulp wood and other fibres to meet the multitudinous variety of the ever-growing demand for paper and allied products in modern civilization.

The thorough and practical handling of a vast subject of such widespread interest and importance, in the course of 20 chapters, covering only 202 royal octavo pages, is indeed highly commendable. The bibliography of books and periodicals on pulp and paper-making at the end of the first chapter, a subject and name index at the end of the book and generous references to literature throughout the text, add greatly to the value of the treatise. It is, therefore, hoped that the book would prove of use and interest not only to those who are actually engaged in the pulp and allied industries, but also to students, who wish to add to their knowledge of the technical aspect of these industries. Dr. Grant is to be heartily congratulated on his able and praiseworthy performance.

M. P. BHARGAVA.

Tantalising Time. *Actualites Scientifiques et Industrielles*—Par Joseph Sivadjian—Vol 2, No. 616, 18*fr.*; Vol. 3, No. 617, 20*fr.*; Vol. 4, No. 618, 15*fr.*; Vol. 5, No. 619, 10*fr.*; Vol. 6, No. 620, 10*fr.* (Herman & Cie, Paris), 1938.

Down the ages, since the dawn of rational human speculation, philosophic and scientific thinkers have attempted to solve the problem of *Time*, and even at the present day, notwithstanding the staggering progress achieved by the laboratory sciences, it would be impossible to state that the problem of *Time* has been satisfactorily solved. The booklets or pamphlets under notice are thus welcome as they deal with the analysis of the concept of *Time* from different angles of critical vision. Of these, the second volume deals with specifically or distinctively metaphysical problems with pointed reference to Neo-Platonic ramifications and Scholasticism. *Time* was once understood to be "law of phenomena". In the third volume, *Time* is sought to be grasped through the *Psychological* approach. Reference is made to the view that *Time* is the "form of consciousness" to "formation", "duration" and allied topics. In the fourth, the "Physical problem" in respect of *Time* is discussed. "Spatio-temporal continuum", "Relativity", "Reversibility of space" and "Irreversibility of time" "Atomic measure of time and space" figure prominently in this volume. *Time*, understood as a physiological problem, is the subject-matter of the fifth volume. After pointing out the physiological basis of time, the author notes that animals are not devoid of the sense of time. Perhaps Plant-life too has a characteristic sense of time. In the sixth volume, *Time*, understood as a problem of the subconscious, receives a fairly detailed study. After a brief analysis of the notion of Time in dreams, questions are referred to such as—Is there time-sense in dreams? Do we transcend time in dreams?—and so forth. The author indicates the conclusion that there is no time-sense in dreams. Dreams and hallucinations are analysed and

their *differentia* noted. The Relativity of time is emphasized.

After a fairly careful study of the contents of the volumes under notice, I find that the concept of *Time* continues to be as tantalising as ever. Except within the circumscribed sphere of the physicist and the mathematician, time-space, that mysterious commingled entity, has not been properly understood. Centuries ago, *Nyaya-Vaiseshika* thinkers decided that *Time* and *Space* are irreducible, independent cosmic constituents. *Kāla* (Time) and *Dēsa* (Space) were considered to be independent substances (*Dravyas*). While scientific orthodoxy everywhere means a dictatorship to which implicit allegiance or obedience is demanded, the uninitiated man in the street is generally unwilling to bow to such dictatorship. Attempts to reduce time to space, space to time, and create *time-space* or *space-time a la* the super-man of Shaw must appear unconvincing to the commonsense man. Philosophic or metaphysical thinkers, full of years and wisdom, quibble about "Time is in a person", "A person is in time", and so forth. In the ultimate analysis, *Time* is identified with the Absolute, the cosmic Creator Himself. (The *Gita* text has it—"*Kalosmi-lokakshayakrit*"—I am Time, the Destroyer of the worlds.) In the peculiar program of psycho-physical purification or perfection adumbrated by YOGA, *Time* is understood in purely physiological terms in reference to inhalation and exhalation, and control of both is believed to lead to extraordinary experiences. Astronomers still delightfully speculate about life on other planets. If Mars is at all inhabited, what sort of a time-sense would the denizens of that ruddy planet have? Speculations like these must show that *Time* must for ever continue to be tantalising.

Not time, but the effects of time, are so devastating that man desires to escape from them. Hair-dye, powder, and cold-creams with the amusingly adventitious aid of which advancing age and its inevitable effects are sought to be checked, though in a familiar and flippant atmosphere, indicate a profound truth, the basic significance of which had been correctly appreciated centuries ago by ancient Indian master of thought. *Time* means *motive* or motivation. Motive means *action* ethically or morally good or bad. *Action*, in its turn, means imprisonment or bondage in a series of births and deaths in the labyrinthian den of transmigration. Release from this sort of imprisonment has been held the goal of life, of man's moral effort and endeavour.

Thus, the concepts of *Time* and *Eternity* continue to baffle and tantalise mankind. Whether we have an "Expanding Universe", or a CONTRACTING UNIVERSE, whether Evolution is emergent or creative, the tyranny of *Time* is there. The irreversibility of time is the most sensational phenomenon. A moment lost is lost for ever. Recall is possible in the shape of memory-imagery. But a recalled bit of experience is not the experience itself in its original setting, and intensity of intellect, emotion, and volition. That is why Buddhism and the Vedanta, though metaphysically poles asunder, yet agreed on the importance of *Time*. Life may be long or short. While we live, let us live correctly, morally and spiritually. That is a message, the value of which is untouched by the passage of *Time*. Time flies and the rest is lies, observed old Khayyam. *Fugit tempus*. Beyond this, even the modernest Science does not seem to have advanced. On the depth of thought revealed the author of the booklets deserves to be sincerely felicitated.

R. NAGARAJA SARMA.

Text-Book of General Zoology. By W. C. Curtis and M. J. Guthrie. Third Edition. (John Wiley & Sons, New York; and Chapman & Hall, London), 1938. Pp. 682. Price 18*sh.* 6*d.*

The authors have endeavoured to make this edition of their book more exhaustive than the previous editions; and the present volume contains nearly a hundred pages more than the second edition. The chapter on the History of Zoology has been omitted and in its place an introductory chapter with a list of books of general interest has been added. An important addition to this book is a chapter on Chordata which had been a serious omission in the earlier editions. Some portions of the book have been revised, and illustrations of typical animals of various phyla are a useful feature of this book.

In these days of intense specialisation in Zoology, it is relatively rare to come across a book dealing with various aspects of Zoology which would be helpful to a beginner or a layman. The book under review fulfils this requirement and it is truly a "General

Zoology" containing brief but clear account of almost every aspect of Zoology. Topics like Nervous Co-ordination, Experimental Breeding, Sex Determination, to mention only a few, have been detailed in such a manner as to enable a layman interested in the principles of Biology to follow them with minimum effort. This book would form a very useful addition to the libraries in the Colleges and High Schools in India.

On page 510, an illustration of one of the Gobioid fishes has been wrongly labelled as *Anabas scandens* and it is hoped that this error will be rectified in a future edition of this valuable book. A. S. R.

Plant Ecology. By J. E. Weaver and F. E. Clements. Second Edition. (McGraw-Hill Publishing Company, Ltd., London and New York), 1938. Pp. 601. Price 24*s*.

The first edition of this notable text was published in 1929, but the marked progress that has taken place during the last decade in the field of ecology has already led to some important changes in the present edition. The number of pages has increased by 83 and more than 400 new references have been added to the Bibliography. The whole text is generally brought up-to-date but the most important additions are concerned with soil science and the conservation of water and wild life. The value of the book is enhanced by the fact that it contains much practical advice on the methods of ecological study.

The text seems to have been written primarily for American requirements, but teachers, research workers and post-graduate students in India will also find it of great value. It is hoped that in the next edition the authors will also try to include some of the work done by Indian Botanists in this line. P. MAHESHWARI.

Biology for Senior Schools. Book I. By M. R. Lambat, M.A. (Macmillan & Co., Ltd., London), 1937. Pp. 218. Price 2*sh*. 6*d*.

With the increasing appreciation of the fundamental value of science teaching in secondary education, the study of life through Plant and Animal Biology is regarded as an essential part of child training. The object of such a study is to stimulate the natural curiosity of the child which usually finds expression in the why, what and where of things in general. If the scheme of studies should contemplate such an instruction by well-planned and intelligently guided scheme of investigations into the natural history of the Animal world, we have no doubt that the child is not merely initiated into the mystery of Life but would also be equipped for good citizenship.

The book under review is a well-planned book on Elementary Biology and is a successful attempt at creating the student's interest in biological studies. An animal or a plant could be studied from various aspects. Its structure, both external and internal, its functional activities, its relations to the animate and inanimate environment and its developmental history are a few of the aspects of such a study. It follows therefore that the study of Biology in the field would be the most successful and useful one.

Within a short compass, the author presents an extremely interesting and instructive account of plants and animals and as an introduction to biological studies, the types selected are thoroughly representative besides being the commonest. The first nine chapters deal with the attributes of living organism and bring out lucidly the essential differences between plants and animals. This aspect is fundamental as it emphasises the Unity of Life and gives the student an idea of his own position in the animal kingdom.

In the later chapters the author gives an idea of seasonal changes, both in animals and plants and describes in an easy manner the functions of the different parts of a typical plant. The last four chapters, brates, are useful in the sense that without going into details, the author describes the animals with reference to their feeding, movement and reproduction. This it seems to us, would stimulate in the student interest in the subject without developing in him a horror for minute structural details.

At the end of each chapter, suggestive questions are included. The simple experiments described to demonstrate the various functional activities of plants and animals are valuable for a correct appreciation of the subject-matter. The book is well illustrated and the get-up is good.

We recommend the book to all High Schools where Biology is taught as part of the Secondary Education. B. R. S.

Electron Optics. By L. M. Myers. (Chapman & Hall, Ltd., London), 1939. Pp. 618. Figs. 379. Price 42*sh.*

The expression "Electron Optics" was used by Dr. Davisson, twelve years ago, to describe the interference of the electron waves. The book under review, however, deals with the geometrical optics of the electron, moving in non-homogeneous fields. The chief contributions to this science have been made by the German and the American workers. The two books, *Geometrische Elektronenoptik* and *Beitrage zur Elektronenoptik*, are well known; no authoritative text-book on the subject of Electron Optics was published in the English language, and so the author, who is associated with the Marconi Company, comes forward with the present volume.

In this book, Mr. Myers gives an exhaustive treatment of the subject; both theoretical and experimental details are included in the book. He first compares the electrons with the light corpuscles, then treats the electron trajectories mathematically, and finally, he describes the various methods to build the electron multipliers and microscopes and how they may be used. The Bibliography at the end of the book would be very useful to the worker in this field.

Without hesitation I would recommend the book to an Electron Optician. But I do not think that the author's claim that the book is written primarily for the graduate student, who intends to take electron optics as a career, can be substantiated. The large number of errors left behind in proof-reading, specially in the mathematical treatment (*e.g.*, not less than 30 in Chapter II) make the book rather unsuitable for a graduate student. The impression is produced that the book was rushed through the press.

K. R. DIXIT.

Agricultural Marketing in Northern India*

THOUGH the literature on the subject of the marketing of agricultural products is rapidly increasing, much of it covering the same ground, drawing attention to the same drawbacks and suggesting more or less the same methods of improvement, the field cannot by any means be considered to be fully covered or the points of view exhausted. The importance and complexity, moreover, of the subject in respect of such a large continent like India with its wonderful diversity of agricultural products, and the fact that so little has been accomplished by way of improvements in marketing methods in spite of these studies justify a larger and larger amount of attention being bestowed on the subject. It is from this point of view that we welcome this new publication as a further helpful study. Though the author has confined his study to the main products of Northern India such as wheat, sugar, rice, oilseeds, cotton and jute, it is obvious that to a great extent his observations and conclusions will apply to other parts of the country as well and to many other kinds of products also. The restricted scope may be said also to increase the thoroughness and the accuracy of the book while the commodities dealt with practically comprise the main products of the country as a whole at the same time. The author has laid all the important published literature on the subject fully under contribution, with the exception of the results of the recent marketing surveys by the Government of India, and the book is fully documented.

The need for an improvement in the prices of agricultural produce in general, both in the overseas market and within the country itself and for securing to the grower as large a share as possible in this price as distinguished from the share of the merchants and middlemen are the main themes and both receive adequate attention. Much familiar ground is covered but many of the observations will bear emphasis and repetition. The great slump in the prices of produce and the consequent depression are attributed to merely overproduction; the causes, mainly political, economic and fiscal, which have led to a shrinking in the purchasing power of the masses are, we think, not given the importance they deserve in this perplexing situation. The author's remarks on the value of the preferences under the last

* By S. H. Husain, B.COM., PH.D. (ECON.), with a Foreword by Sir Harry Lindsay, K.C.I.E., O.B.E., London. (George Allen & Unwin, Ltd., London), 1938. Pp. 342. Price 15/-.

Ottawa Trade Agreement are interesting; Indian castor holds the market by virtue of its high quality, the preference to groundnut is shared by the Colonies also who are India's chief rivals; in respect of linseed, it is a case of taking away with one hand of what has been given with the other—a view which is supported by facts and figures. In respect of cotton, however, the author would have us cultivate and retain the goodwill of the overseas markets and would probably support the sacrifice which the mill industry has been asked to make for this purpose under the new agreement. We also venture to think that the importance of judicious protection might well have been emphasised a little more, especially with the example of the Indian sugar industry before us which, by the way, receives fairly exhaustive treatment. Improvements in quality of produce, cleanliness, freedom from mixtures and grading are of course dealt with in this connection and the author draws attention to the fact that such special produce fails to secure the premium that it is entitled to and that the incentive is not, therefore, sufficient. The need for widening markets, for scientific research for finding other uses than the well-established ones, and for special efforts to advertise are indicated, the example of the Indian tea industry being held up as a model and that of the Indian jute industry as a warning. "Living in the paradise of monopoly and basking in the sunshine of high prices", the jute industry has grossly neglected its permanent interests and now has to helplessly look on while its markets are steadily shrinking with the rapid growth of other methods and materials of storage.

As regards internal markets and the improvement of the position of the grower *vis-a-vis* the merchant, the subject of transportation, both by road and rail, of regulated markets of linseed warehouses, of storage facilities, of financial assistance for holding up produce and sale through co-operative societies, all receive clear and forceful treatment. We should strongly plead with the author for the provision of proper storage facilities, both in the primary and the central markets. The underground structures, both *katcha* and *pucca*, and even the cement concrete improved ones should be replaced by good above-ground bins, preferably of the elevator type. The present ones are primitive to a degree and are relics of a troubled past, when grain stores had to be hidden quite as much as gold and silver. The wastage is large even at the best of times, and all but complete if conditions are unfavourable. Labour at these stores is no holiday occupation and poverty and custom alone ensure it at present. It is no argument to say that the failure of the costly Lyallpur Elevator was not a success; the author fully explains the reasons and we would only add that changes considered novel and unsuitable not many years ago have become the common practice under the rapidly changing conditions in India. The mistakes of the past can easily be avoided and smaller and less costly types of elevators suited to the conditions of the ordinary *mundies* can be erected. The inadequacy of finance through co-operative agencies is forcibly brought out by the instance of the U.P., where out of 124 crores of rupees of rural debt, only about 4 crores comprised amounts advanced by Government and co-operative societies put together! It is true that co-operative sale societies have not been a uniform success but there is no other method which holds promise of help to the grower more than these institutions. The author's remarks on the failure or partial success of the Commission shops of the Punjab and why ryots do not patronise them in spite of the decided and undoubted advantages they afford are valuable and reveal the kind of mistakes to be avoided. The author has throughout stressed the need for making agriculture more paying than it is at present if any real and permanent amelioration is to be brought about and for increasing production all along the line, taking full advantage of the results of research in reducing costs, avoiding losses, and increasing yields. As observed in the *Foreword* to the book by Sir Harry Lindsay, "there is no shortcut to a solution of the problems which the author has so well described", but the general lines of attacking them along a wide front are comprehensively indicated and we should consider the book a welcome contribution to the rapidly growing literature on this subject.

A. K. Y.

Trout Culture in Ceylon

THE recent treatise of Mr. Philip Fowke, Superintendent of the Ceylon Fishing Club's Hatchery at Nuwara Eliya, on "Trout Culture in Ceylon"[1] should prove of special interest for all connected with Trout Culture in India. The work is of special significance as it is the first of its kind that deals in a comprehensive manner with trout culture in Indian waters (*sensu lato*); the information regarding the cultivation of trout in these waters so far published is contained in a number of short and scattered articles in various journals and is not easily available.

The author has confined himself to the culture of the Rainbow Trout, as Brown Trout are not bred in the Ceylon Hatcheries, partly owing to the comparatively higher temperature of the water, but mainly owing to the fact that in Ceylon the cock and hen fish are never in season at the same time. The latter is a very important point for pisciculturists, as workers are liable to fertilise ripe ova with unripe milt with disastrous results.

Mr. Fowke deals with the culture of the Rainbows in eleven sections: Introduction of Trout in Ceylon, Spawning and Stripping, Hatchery, Nursery Ponds, Conditioning and Transport of Fry, Transport of Eyed Ova, Care of Streams, and finally, the Wanderings of the Rainbow Trout. After giving a brief description of the Nuwara Eliya Hatchery and how Trout were introduced in Ceylon, the author discusses in detail the spawning and stripping operations and gives an account of the origin and history of artificial fertilisation and up-to-date hatching methods. He directs particular attention to the desirability of removing dead eggs daily before eyeing without disturbing or injuring the remainder, as this has been the main reason of the great success of piscicultural operations with the Rainbow Trout in Ceylon.

In the section on Mortality of Trout, a brief account is given of the various diseases that attack young and old fish in Ceylon. This subject, although widely studied in America and Europe, has, owing to the lack of research facilities in the hatcheries, received very little attention in India.

[1] *Ceylon Jour. of Sci.*, Sec. C, *Fisheries*, Nov. 21, 1938, 6.

The account of the construction of Fry and Nursery Ponds, Conditioning and Transportation of Fry and Ova, though mainly based on the conditions in Ceylon, should prove of value to pisciculturists in various parts of India also. The great success achieved in transporting fry without changing the water in Ceylon is very interesting.

In the section dealing with the care of streams, the outstanding features are the choice of waters for the Brown and the Rainbow Trouts, the methods for providing and conserving food and the marking of fish for studying their movements, growth, etc. Special reference is necessary to the observations on the wanderings of the Rainbow Trout in Ceylon. It was till recently a puzzle to all trout culturists in India as to why the Rainbows disappear from all waters. The author has now shown that what is regarded as the freshwater Rainbow is in reality a different species, the *Salmo rivularis* or *gairdnerii* or the steelhead which is an anadromus fish. The number of lateral line scales, which, according to the author, is a character of considerable diagnostic value, serves to distinguish this species from the purely freshwater *Salmo shasta*. It would thus appear that the disappearance of Rainbow from Kulu and some of the Kashmir Trout streams may in reality be due to the instinctive migratory habits of the species, as all the Rainbows introduced in India proper are the progeny of the same stock. The author suggests that efforts shoud be made to produce a strain of Rainbows from which the wandering instinct has been eliminated, but before any step is taken in this direction it is important to determine the nature and extent of the wandering of the species. In this connection, it is very significant that the U.S. Bureau of Fisheries, in co-operation with the State of California, is rearing several strains of Rainbows in the hope of eliminating the wandering instinct. In this connection, a question arises as to which factor or factors determine the wandering habit of this species, since it spawns freely in fresh-waters and also finds plenty of suitable food in this *milieu*.

The descriptive account is accompanied by a number of beautiful illustrations of filtering, hatching and distributing troughs; pools, lakes, fry and nursery ponds, etc.,

and a layout plan of the Nuwara Eliya Hatchery. The author is to be congratulated on the production of a treatise which should not only be of great interest to all those interested in Trout Culture in tropical waters, but also serve as a work of reference in all Trout Hatcheries.

GULAM MUSTAFA MALIK.

Larvicidal Fishes and Their Identification

MALARIA is one of the major scourges of India and its prevention and cure have engaged the attention of the Medical and Public Health authorities in India for well over quarter of a century. The problem of the prevention of Malaria is many-sided, but from the time of the discovery by Sir Ronald Ross that the Anopheline mosquito was the carrier of the malarial parasites, it has been the aim of the authorities to control the incidence of Malaria by controlling the breeding of the carrier-mosquitoes in various ways. It has been known for many years now that some species of Indian freshwater fishes have a special preference for mosquito larvæ as food, and that their introduction into tanks, ponds and wells would go a long way to control the mosquito population in the neighbourhood of human dwellings. Medical men naturally turned their attention to the fishes of the aquatic areas in which mosquitoes bred, but found themselves in difficulties in the identification of the fishes. The only standard works on the Fishes of India were none too easy to refer to, burdened as they were with a mass of technical details, and the result was that fishes were often wrongly identified, sometimes not at all. The medical man, who is a field-worker interested in the control of Malaria by the use of larvicidal fishes, would appreciate a simple guide to the identification of freshwater fishes in India. In respect to this, *Health Bulletin No.* 12, *Malaria Bureau No.* 4 (Second Edition, Revised and Enlarged), pp. 1–47, pls. i–vii (1938), by Dr. S. L. Hora and the late Mr. D. D. Mukerji, of the Zoological Survey of India, seems amply to fulfil the needs of medical men in the field. The *Bulletin* bears the title "Table for the Identification of Indian Freshwater Fishes, with descriptions of certain families and observations on the relative utility of the probable Larvivorous Fishes of India"—a sufficiently self-explanatory title which renders a review somewhat superfluous. Nevertheless, the value of a neat and useful compendium of information on Indian Freshwater Fishes, like the present *Bulletin*, will hardly suffer by emphasis on its merits.

To the medical man in the field with the best will in the world, a reference to a well-arranged identification table of Indian Fishes would be of little help if he has not only to face terms like "procumbent predorsal spine" or "pro-current caudo-dorsal", but also to find the structures referred to in the fish under examination. The few pages devoted to the explanation of the principal terms and of the modes of measurements used in the description of a fish are, therefore, a very useful prelude to the Table of Identification which, with the eleven clear sketches of the external morphology of fishes (text-figures 1–11), renders the task of identification easy. The Table deals with 59 families of fishes, of which 11 are known to be larvivorous. The generic identification of the larvivorous families of fishes is facilitated by the inclusion of keys in footnotes, but a separate generic key of the Cyprinidæ is given as this family includes several genera of potential utility in anti-malarial work. The three appendices which follow are at least as valuable as the Table of Identification. Appendix I contains descriptions of exotic and Indian families of probable larvivorous fishes with information of value to those interested in mosquito-control work, printed in italics or in thick type. Appendix II contains notes on the relative importance of the various exotic and indigenous species of fish as destroyers of mosquito larvæ, and deplores the fact that no serious attempt has been made in this country to elucidate the value of exotic and Indian species of fish as destroyers of mosquito larvæ under Indian field conditions. A useful list of references on Malaria and mosquito control and on larvicidal fish follows. In Appendix III it is pointed out that the rough identification of the fish in the field should, in many cases, be followed by expert identification which is possible only in institutions with large reference collections of fish and literature such as are available in the Indian Museum. The collection and preservation of fish, simple as they appear, need a little expert guidance, and the authors give in this appendix a few simple directions as to how fish may be

observed in their natural haunts, how they may be collected and preserved if wanted for museums, or how they may be transported alive when required for anti-malarial work. The seven plates at the end with clear dot and line drawings of Indian freshwater fishes which enhance the value of this little *Bulletin*, should help not only medical men, but also students of fishes, to familiarise themselves with the features of some of the principal Indian larvivorous fishes.

The *Bulletin*, which is priced at 7 annas or 8*d*. a copy, is published in Delhi by the Manager of Publications, and may be obtained from the Agents to the Government of India Publications in India and from private book-sellers, a list of which is given on the page opposite to the Prefatory Note.

H. S. R.

OBITUARY

Dayaram Sahni, M.A., C.I.E.

RAI BAHADUR DAYARAM SAHNI, M.A., C.I.E., late Director-General of Archæology, died suddenly on the 7th March 1939 of heart failure at Jaipur, where he was employed as Director of Archæological Researches since 1935. Rai Bahadur was the first Indian to be trained in the modern methods of archæological excavations, and by his death India loses a most experienced archæologist.

Rai Bahadur belonged to a respectable family of Khatris from Bhera in Shahpur District, Punjab. He was born on 16th December 1879. After passing his M.A. from the Oriental College at Lahore, with Sanskrit as his main language, he was selected for the archæological scholarship instituted by the late Lord Curzon's Government, with a view to preparing suitable Indian scholars for archæological work. Sir John Marshall, who was then organising the first systematic campaign of excavations in India, found in Rai Bahadur a willing and capable assistant. He worked at the excavations conducted by the Department at Sarnath near Benares, Kasia, the scene of the Great Buddha's decease. Sahet Meheth, the ancient Sravasti, Rajgir in Bihar, Mandar near Jodhpur, and Rampurva in Champaran. At Sarnath, Mr. Sahni studied the finds and prepared a comprehensive catalogue and a guide to the ruins. After a year, at the Lucknow Museum, where he worked as Curator, Mr. Sahni's services were lent to the Kashmir State, in December 1912. During the next four years, Mr. Sahni studied the architectural remains in Kashmir, and excavated at several places, among which may be mentioned Avantipur, the city of Avantivarman, Parihaspur, Hushkur, and Martand, the well-known site of a temple in classical style. In 1917, Mr. Sahni returned for work, to Lahore, where he took over the Hindu and Buddhist monuments in the United Provinces and Punjab to his charge. After carrying out important archæological work at Deogarh, Sarnath and other places in the United Provinces, Rai Bahadur Sahni then commenced a series of excavations at Harappa, which was shortly afterwards recognised as the foundation of our knowledge of one of the earliest cities of the Indus Valley culture. Since 1925, Rai Bahadur Dayaram Sahni was engaged at the Headquarters of the Government of India, first as a Deputy Director-General, and finally in July 1931, when he became Director-General. Unfortunately, his advent coincided with an era of unprecedented curtailment of activities owing to the need of retrenchment and his three years' tenure as Director-General was consequently very much handicapped and the lowest watermark of funds allotted to this cultural activity was reached. However, he carried the Department through this period and on retirement found fresh scope for his capacities in the almost untapped and rich archæological field in the State of Jaipur. His excavations at Birat, where he unearthed one of the earliest Buddhist *stupas* in Rajputana, were highly successful. He carried out one or two seasons' work at the ancient city site of Naliasar-Sambhar near the well-known salt lake and at the time of his death was engaged in another important excavation at Rairh where he had hit upon another rich site of the early period.

Rai Bahadur Sahni was awarded the title of C.I.E. after his retirement in 1935.

Besides the two publications on Sarnath, Rai Bahadur contributed numerous other articles to scientific journals, particularly on Epigraphical subjects, bringing to light and interpreting many records of the past, particularly from the United Provinces and Northern India.

INDUSTRIAL SECTION

The Chemistry of Detergents

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A DETERGENT is broadly defined as "a washing or cleansing agent such as soap, scouring compositions, etc." and detergency as washing or cleansing. The detergent action of the alkalis and of certain of their salts such as the silicates and phosphates is well known and, more recently, the detergent action of colloidal clays has been recognized. Soaps were the earliest organic detergents and, although numerous synthetic organic detergents with certain advantages have been evolved, the soaps have by no means been abandoned in detergent practice on account of their fundamentally valuable properties and their cheapness. In fact the synthetic detergents are in general not as satisfactory as soap for the usual fabrics, so long as the water is soft. The detergent action of alkalis may be partly attributed to the soaps formed from the saponifiable matter present in the material being deterged, and the action of colloidal clays to their adsorptive capacity. Used in conjunction with soap, the addition of colloidal clay increases lathering power, makes a firmer and more powerful lather, and absorbs and neutralizes free alkali.[1] The washing of textiles, hair or skin with a detergent composition containing a sulphonated product of the Igepon type and a colloidal clay like Bentonite has been claimed (*Fr. Pat.* 820,661).

Much attention has been directed in recent years to the mechanism of detergent action. Partly as a result of the truer insight now available into the many factors governing detergent action and of the more stringent necessities of modern textile processing with regard to the delicate nature and variety of the fabrics and to the importance of the time factor in production, it has been possible for the synthetic organic chemist to arrive at substances which are efficient detergents and which have in addition to their detergent action a number of desirable properties which enable them to be used under widely varying conditions.

In a recent symposium[2] organised by the International Society of Leather Trades Chemists a very comprehensive and illuminating survey has been made of the theoretical aspects of wetting and detergency. While the newer concepts of the physics and chemistry of surfaces, due to Freundlich, Hardy, Langmuir, Adam and Rideal, have led to better understanding of the arrangement of detergents and emulsifying agents at interfaces and of the molecular forces which play a part in the gradual accomplishment of the ultimate result of detergency, this has simultaneously complicated the work of the manufacturer of textile auxiliary agents, since the processer has begun to realise that the detergent for a given purpose and set of conditions may be entirely unsuitable under other circumstances. To the synthetic organic chemist, however, the broadening of the theoretical bases of detergent action and the quantitative considerations and methods that have emerged in consequence have meant the opening up of a new and extensive field of research.

A wetting agent need not *per se* be a detergent, but in general wetting or penetrating power towards textile fibres is a desideratum in a detergent. Whatever may be the theory finally adopted regarding the mechanism of detergent action, it is as necessary for a detergent as for a dyeing process that the reagent must initially come into intimate contact with the surface of the textile material. Adsorption should then take place, the detergent having a greater attraction for the surface to be deterged than the grease, oil or "dirt" which is to be removed. Rideal[2] has suggested that detergents, like dyes, are first adsorbed on the outer surface of the fabric and then migrate into the interior accessible surface. The oily or greasy film is then loosened on account of its displacement by the detergent, the oil collecting into comparatively large globules.[3] Dependent on the agitation to which the scouring liquor and the deterged surface are submitted and the emulsifying power of the detergent or of a second added substance, an emulsion of the oil may be formed or the

oil may be removed by a process of flotation. The last factor which determines the detergent efficiency as measured by any practical test, such as whiteness or wax content, would be the prevention of redeposition of the oil or dirt on the surface of the fabric; here presumably the protective colloidal power of the detergent is concerned. Rideal[2] considers that the polar head of a detergent may also fulfil a definite chemical function in addition to the more usually recognized physical function of rendering a hydrophobic surface hydrophilic in character; loose molecular complexes may be formed between the polar heads of the detergents and the alcoholic groups in the oil or grease or the keto-imide groups in protein "dirt". The hypothesis would be limited by the nature of the dirt and by the availability of detergents which do not possess a polar head or ionising group.

The two stages of adsorption at the interface and migration into the intermicellar spaces of a fibre may be difficult to demonstrate experimentally in the case of the common reagents not susceptible to identification by colour reactions. Anacardic acid, which is a constituent of cashew nut shell oil and, being a derivative of salicylic acid, gives an intense coloration with ferric chloride, should prove useful for studies in the mechanism of detergent action. Carrying a pentadecadienyl residue *ortho* to the phenolic hydroxyl, the sodium salt of the acid has marked wetting power and its detergent properties are under examination.

The factors involved in detergent action are so complicated that the problem of measuring the detergent efficiency of a given substance is beset with even more difficulties than the measurement of wetting power;[4] on the other hand a quantitative assay of detergency is fundamental to a study of its relation to chemical constitution. The physical properties usually determined, such as surface tension or interfacial tension in terms of the drop number, wetting intensities, contact angles, etc., are not related in any known manner to actual detergent power.[5] Zakarias[6] regards protective colloidal action as the essential criterion of detergent efficiency, but it is common knowledge that the two do not necessarily go hand in hand, judging detergent power by any practical test. In a discussion of soluble soap, insoluble soaps and synthetic detergents, Crowe[7] has briefly outlined theories of detergency and has referred to the dependence of the choice of a detergent for a given process on the process itself and on the composite quality of the detergent, rather than on the consideration of individual factors. The sulphonated oils (Turkey Red oil, Prestabit oil, etc.), whatever the degree of sulphonation may be, are devoid of detergent power in spite of possessing other valuable properties such as wetting, dispersing and emulsifying power. This contrast in properties, pointing to the more specific requirements in an organic compound to develop detergency, is further exemplified by the alkylnaphthalene sulphonic acids (Nekal BX, Perminal W, Oranit), which are powerful wetting agents, but not detergents. The distinct aspects of wetting and solvent action involved in detergency are recognized by the use of non-detergent wetting agents like the Nekals in conjunction with chlorinated and other solvents. Likewise it has been suggested that the detergent properties of the sulphated alcohols are improved by admixture with unsulphated alcohols; the contrary suggestion that the presence of unchanged fatty alcohol acts detrimentally on the detergent power of the sulphate has also been made.[8] The explanation probably lies in the relative amounts of the unsulphated alcohol present. A direct measurement[9] employing washing or kier boiling tests is essential. From the practical point of view the analysis of the factors underlying detergent action would indicate that the nature of the material to be deterged and the nature of the "dirt" to be removed are both to be taken into account in assessing the efficiency of a detergent; the conditions with regard to temperature, pH, etc., must also be closely defined. Confining oneself to a comparative study of the detergent efficiency of members of a homologous series, the determination of an individual property, such as interfacial tension or foam number, may give useful indications. Thus Götte[10] found that in the series $C_nH_{2n+1}-O-SO_3Na$ the maximum "washing effectiveness" at 60° corresponded to the maximum Steipel foam number. The alkaline washing effectiveness in soft water was a maximum at C_{16}, but it was observed that for every temperature and degree of water hardness there was an optimum alkyl sulphate. The maximum washing efficiency was displaced in the direction of increasing chain length with increase in temperature and in the hardness of the water.

In assessing the value of a detergent to be employed in textile processing, a factor of great importance is its stability to the reagents involved, particularly acids and alkalis. Resistance to hard water or ability to disperse calcium soaps[11] is another desirable characteristic. Used in soft water, soap is an excellent detergent and its survival, in the face of strenuous competition from a host of synthetic auxiliary agents, as still the most widely employed detergent is ample evidence of its value in this regard. Its chief drawback is its instability to acid and to metallic ions, such as magnesium and calcium. For the scouring of cotton materials, the reagent needs to be stable to alkali; substances such as Igepon A, Avirol and Aerosol OT, which are esters hydrolysable by boiling alkali, but have otherwise useful properties as wetting and emulsifying agents, would fail to function in a kier boiling operation.

While synthetic detergents are usually built on a soap model consisting of a hydrophobic and a hydrophilic half, quantitative examination of a series of detergents would readily show that the structural features that are favourable to the conferment of detergent power may to some extent be defined, but it is no more possible than in the case of the relation between chemical constitution and physiological action to arrive at forecasts of the constitution of substances with maximum detergent power. The precise degree of the detergent power is a specific property of a particular compound, depending on the interplay of forces between the various groups or atoms in the molecule.

On the basis of our present knowledge of the probable stages involved in detergency, and as a guide to synthetic effort, an ideal detergent may be postulated to have the following properties in the optimum degree: (1) affinity for the surface to be deterged; (2) solubilising or peptising power towards oil or grease; and (3) protective colloidal action. Other favourable factors are solubility in water and ability to function under adverse conditions, *e.g.*, in hard water and at wide variations of temperature, pressure, acidity and alkalinity. Solubility in water is not intrinsically necessary in a detergent, since the example of adsorbent clays as detergents has been quoted; but water-insoluble detergents can only function where the agitation employed is such that access of the detergent to every part of the deterged surface is ensured throughout the process; in any textile operation involving detergents, as in kier boiling, the fibrous material would act as a filtering medium and the detergent would be rapidly put out of action. A certain minimum solubility in water is, therefore, essential in a detergent for textile purposes.

Considering the three requisites in a detergent outlined above, fulfilment of the first would be dependent on the nature of the fibre, and the constitutional characteristics of a detergent for cotton and the cellulosic fibres would differ from those of a detergent for wool and the protein fibres. Experiments in this laboratory have naturally been concerned almost exclusively with cotton and, although they are still in the early exploratory stages, it has been possible to obtain some indication of the dependence of detergent power on the affinity of the reagent for the fibre or, as it may be termed by analogy with dyestuffs, on its substantivity. The nature of substantivity, which will be discussed elsewhere in more detail with reference to synthetical experiments in the Naphtol AS group, is still obscure. In the case of the polypeptide fibres containing free and potential amino and carboxyl groups, the explanation of their behaviour towards dyes and other electrolytes on organic, colloidal or electrochemical grounds can all be correlated. The nature of cellulose largely rules out the possibility of chemical combination; we are, however, now aware that the cellulose molecule is not as completely inert as usually conceived and the hypotheses, confirmed by X-ray evidence, of the constitution of cellulose as long chains of anhydroglucose units held together laterally by residual forces and of the micellar structure of the cotton fibre, are adequate to account for the behaviour of cellulose in processes such as mercerisation and towards dyes and other reagents for which it exhibits affinity. The dyestuff chemist has accumulated data regarding the structural features of an organic compound which are favourable to substantivity to the cotton fibre. Our knowledge of the subject, due mainly to Ruggli,[12] may be briefly set down as follows, in so far as it is relevant to the present purpose. (1) The substantivity of symmetrically constituted azo dyes has been explained by Meyer as due to the straight chains of the cellulose molecules attaching themselves, probably by means of covalencies,

to the straight chains of the dye molecules. The non-substantivity of disazo dyes from benzidine substituted in the *o*-position to the diphenyl linkage has been ascribed to alteration in the co-planar arrangement of the diphenyl rings, any deviation from a straight linear structure leading to diminished substantivity. The hypothesis has its limitations and exceptions, but it might offer useful clues to the relation between the substantivity of a detergent and the presence in the molecule of straight chains of carbon atoms which may lie adsorbed on the glucosidic chains of cellulose. (2) The effect of the acid amide group (-CO-NH-), as evidenced for instance by the much greater substantivity of Naphtol AS in comparison with β-naphthol, is well recognised. The admitted efficiency of a condensation product of oleic acid and taurine as an auxiliary in the scouring of cotton may be cited in this connection; the wetting and detergent properties of a series of compounds derived from fatty acids and aromatic amines, and possessing, therefore, the common feature of an acid amide group, have proved to be of practical interest.[5,13,14] Textile assistants are produced by condensing a sulphonic acid of phthalic anhydride with an amine containing a higher alkyl group, *e.g.*, methylhexadecylamine or p-aminostearanilide, the latter compound carrying two acid amide groups (*Brit. Pat.* 461,054). Perhaps the commonest method in the patent literature of bridging a long and a short aliphatic chain is by means of an acid amide group; *e.g.*, amino-acids (glycine, alanine, etc.) are acylated with high molecular fatty acids (*U.S. Pat.* 2,063,987; *D.R. Pat.* 635,522). Schirm's suggestion that enolisation of the acid amide group to -C(OH)-N- is responsible for the substantivity of Naphtol AS and his deduction therefrom that substantivity is due to the existence in a dyestuff molecule of a chain of conjugated double bonds must be subjected to more careful scrutiny. Assuming for the moment that substantivity plays a part in detergency, it should be noted that acyl derivatives of secondary amines appear in general to be more efficient than the corresponding condensation products of primary amines. On the other hand, a double bond conjugated with the carbonyl is favourable to substantivity, a cinnamoyl-amido group in a Naphtol being more effective in this respect than a benzamido group. (3) Conflicting results have, however, been obtained with regard to the general influence of unsaturation, as represented by a carbon-carbon double bond, on wetting and detergency. Thus the relative values of sodium laurate and oleate were frequently reversed when lauric and oleic acids were combined with various arylamine sulphonic acids. (4) Ruggli regards the sulphur atom as being favourable to substantivity; restricted to definite groupings containing sulphur, evidence may be advanced in favour of the suggestion. Primuline containing a thiazole ring is a well-known example of a substantive dye. The high affinity of sulphur dyes in sodium sulphide solution is probably associated with the formation of -SNa groups. So far as detergents are concerned, sulphonic, sulphuric and thiosulphuric groups are common features, though the evidence of their effect on wetting and detergency is not conclusive. Their influence in increasing solubility in water is obvious, but the introduction of acid sulphate and sulphonic groups does not necessarily improve wetting or detergent power; the opposite effect may frequently be encountered on account of the balance of the detergent being upset by the disproportionate influence of the ionising, hydrophilic part of the molecule. Wetting and emulsifying agents containing a sulphide linkage have been the subject of patents. One example is the sulphate of 2-hydroxyethyl cetyl sulphide (*U.S. Pat.* 2,100,297). Saponaceous organic sulphides have been described by Henkel and Co. (*Brit. Pat.* 470,717). Compounds having the formula $R\text{-}SO_2\text{-}R'Y$ or $R\text{-}SO\text{-}R'Y$, where R is an aliphatic radical of high molecular weight or an *iso*- or heterocyclic radical, R' an aliphatic radical containing fewer than 8 carbon atoms and Y a water-solubilising group, are wetting, cleansing and dispersing agents (*Fr. Pat.* 809,373; *Brit. Pat.* 461,614). (5) The influence of heterocyclic rings in increasing substantivity can be illustrated by dyes containing thiazole, pyrazolone, iminazole, pyrimidone and other ring systems. Wetting, emulsifying and detergent products prepared from heterocyclic compounds have been claimed in recent patents. The sulphonation products of higher alkyl substituted indoles (*Swiss Pat.* 191,011) and imidazole derivatives (*U.S. Pat.* 2,053,822) are two examples. (6) The fact that synthetic wetting agents and detergents are in general polar compounds assumes a special significance in its relation

to the problems of adsorption and substantivity. As pointed out by Ruggli, non-polar molecules are apparently not adsorbed. With the necessary variations for colour on the one hand and the properties of detergency, etc., on the other, a certain analogy may be drawn between substantive dyes and anion-active textile assistants. The influence of the dipole moment on adsorption and substantivity should be of as much interest in the case of wetting agents and detergents as of dyes. (7) While the multiplication of sulphonic groups increases solubility and tends to reduce wetting and detergent power, Ruggli and Braun[15] noticed among a series of azo dyes that there is no relation between substantivity and water solubility. Measurements of the rate of diffusion indicated that all substantive dyes were colloidal and exhibited slow rates of diffusion, but all colloidal substances did not have an affinity for cotton. Substantivity was dependent on chemical constitution, rather than on physical factors, although the dependence of one on the other should be taken into account. The colloidal nature of the solution might in some cases lead to an apparent affinity for cotton, but absorption in such cases was reversible and of a temporary character, rinsing with cold water being sufficient to strip the fibre completely; true affinity should presuppose a definite degree of irreversibility or permanence in the attachment of the adsorbed material to the fibre. The studies of Conmar Robinson, Neale and others on the physical properties of aqueous solutions of substantive dyes have shown that substantivity is directly related to the ability of the dye molecules to form aggregates or micelles. McBain[16] regarded soaps as colloidal electrolytes, *i.e.*, as salts in which one of the ions was replaced by a heavily charged, heavily hydrated ionic micelle exhibiting a high conductivity. Chwala[17] defined most textile assistants as colloidal electrolytes, the properties of which depend on the balance of their colloidal and ionic components. This factor, to the importance of which in a wetting agent reference has been made by Dean,[2] is a vital consideration in the synthesis of detergents. While the tilting of the scale on the fatty hydrophobic part would diminish the solubility in water, and increase the solubility in organic solvents, and *vice versa*, the special properties of the substance as a wetting agent, detergent, etc., would depend on the nature of the two halves and on their balance. Colloidal character would appear to be much more necessary in a detergent than in a wetting agent. Hartley[18] has characterised detergents as "amphipathic", indicating their unsymmetrical duality of affinity, and has demonstrated that they form micelles in solution. Micelle formation was found in some cases to run parallel to detergent action.

Classifying surface-active substances as anion-active and cation-active,[19] the latter have normally no practical interest as detergents, but they have other extremely valuable properties, which have led to their increasing use as stripping agents, finishing agents for the production of permanent finishes and auxiliaries for the after-treatment of dyeings with substantive dyes. Products have been described in which both the anion and cation have active fatty components, an example being dodecylpyridinium laurate; these are devoid of detergent power.

The substantivity of textile assistants has been measured by Mecheels[20] at various temperatures up to 100°. The influence of pH and other factors was studied, but no attempt was made to approach the problem from the point of view of the constitution of the reagents or of wetting and detergent properties. Blow[21] has examined the substantivity of cationic soaps (*e.g.*, cetyl pyridinium bromide) towards wool. The adsorption rose with the pH and temperature; chlorination, followed by mild oxidation with hydrogen peroxide, accelerated adsorption and apparently modified the orientation of the cation, which was possibly attached to the wool surface by its hydrophilic head. Friedrich[22] has shown that highly sulphonated oils exhibit substantivity to wool due to affinity for the basic radicals of the latter; the property was of practical importance since the more or less permanent incorporation of the fat improved the feel, softness, fullness and mechanical properties of the fibre. It should be assumed that only comparatively loose adsorption compounds are formed, as the adsorption varied with temperature, pH, etc. Chemical combination of the fibre, such as the combination of cellulose with organic ammonium halides to produce permanent finishes, cannot be included in a consideration of the substantivity of textile assistants towards fibres.

Apart from the fact that detergents are

usually emulsifying agents, Hartley[23] has demonstrated the solvent action of soaps and synthetic detergents on organic substances sparingly soluble in water. Hartley pictures such solubility as being due to the paraffin-chain ions collecting together in fairly large aggregates or micelles (of the order of 50 ions in each); when the paraffin-chain contains 16 carbon atoms (the commonest number in detergents) most of the paraffin-chain ions are contained in these micelles except at great dilutions in which the micelles break down. The grease, oil or other organic substance forms a liquid solution in the micelles. Although it may have no obvious bearing on detergency, Hartley's work on the solvent action of soap and detergents has great significance with regard to the after-treatment of azoic dyeings with soap or synthetic detergent solutions.[24] Experiments have been in progress in this laboratory on the type of auxiliary agent with reference to chemical constitution and properties, such as wetting, emulsification and protective colloidal action, suitable for a given azoic combination to produce the maximum fastness to rubbing. The after-treatment is usually regarded as a process of removal by emulsification of the superficially precipitated azoic pigment formed from that part of the Naphtol not substantively adsorbed and not removed by hydroextraction; a process of solubilisation must now be assumed to be at least partially responsible for the action. So far as the solubility factor in detergency is concerned, the main constitutional characteristic of a detergent is a hydrocarbon chain of a minimum length. The presence of long chain fatty residues would appear to be essential in an organic detergent, as distinct from a wetting agent; where aromatic ring systems are introduced into the molecule, this is more or less incidental and is based on the availability and cheapness of a raw material, such as a dyestuff intermediate, rather than any vital influence of the aromatic ring on the efficiency of the product as a detergent. It would be noticed in numerous patents taken out in recent years for the preparation of detergents from aromatic amines, phenols, etc., that the introduction of an alkyl group of 6 or more carbon atoms is a necessary part of the synthetic scheme; higher alkylated anilines may be rendered water soluble by the usual methods (sulphonation, condensation with ethylene oxide and then with chloracetic acid, etc.) (*cf. Brit. Pat.* 475,867), leading to products with detergent properties. Even in the case of derivatives of the cycloparaffins, attachment of an alkyl chain is usual. *m*-Laurylamidocyclohexanyl sulphate and other derivatives of cyclohexanol containing an NH_2, SH or a second OH group have been suggested (*Fr. Pat.* 811,478). Hydroaromatic alcohols are condensed with olefines, or alternatively alkylphenols are hydrogenated, and then sulphonated (*Brit. Pat.* 464,491).

One view regarding the importance of protective colloidal power, the third of the postulated requisites for detergent action, has been quoted.[6] The disparity of outlook that is possible in this matter is indicated by the absence of any reference to it in a series of papers on "Wetting and Detergency".[2] In the practical aspects of detergency it may be taken to be an effective factor. The "Congo Rubine Numbers" of chemically pure samples of five commercial products, B (a recently introduced auxiliary agent free from natural fatty residues and from carboxyl and sulphonic groups), Y (sodium salt of oleyl N-methyltaurine), V (sodium lauryl sulphate), G (sodium β-oleyloxyethylsulphonate) and X (sodium diisopropylnaphthalene sulphonate), were 0·3, 0·7, 3·2, 4·0 and 4·5 (in c.c. of 0·5% solution); the relative efficiency, decreasing in the order named, was at least in qualitative agreement with their detergent efficiency in the kier boiling of cotton and, incidentally, their utility in the after-treatment of azoic dyeings. Two of the structural features of organic compounds exhibiting this property were high molecular weight and a balance of hydrophobic and hydrophilic components. Synthetical experiments[14] on fatty acid condensation products of arylamine sulphonic acids pointed to certain broad considerations in the chemical constitution of a good protective agent. Increasing molecular weight generally led to increasing protective action. Unsaturation in the fatty acid chain was a favourable factor, the oleyl derivatives being better than the saturated analogues, and the linoleyl derivatives better than the former; the apparently contrary effect of further increase in unsaturation needs to be confirmed by replacing the mixed fatty acids of linseed oil with pure linolenic acid. The free hydroxyl in ricinoleic acid exerted a favourable influence, the condensation products of ricinoleic acid with

sulphanilic, N-methylsulphanilic and naphthionic acids being the best protective agents in the series examined.

The chemical constitution of detergents may now be reduced to its essentials; a chemical classification of the closely related group of wetting agents has been attempted elsewhere.[2,5,14] As polar compounds of more or less complex character they have a hydrophobic and a hydrophilic half. The hydrophilic or water-solubilising group or groups may be carried at convenient points in the hydrocarbon residue. The hydrophobic half is usually an aliphatic chain, but it may be aromatic, hydroaromatic or alicyclic. The aliphatic chain may be saturated or unsaturated, straight or branched. The effect of the double bond would be to reduce the hydrophobic character of the molecule and increase solubility in water. The effect of unsaturation on detergency is shown by the superiority of sodium oleyl sulphate to sodium lauryl sulphate, although the latter is the better wetting agent. It has been stated, however, that at moderate temperatures sodium lauryl, oleyl and cetyl sulphates all show about the same detergent power.[25] Sodium ricinoleate is a better detergent than the oleate, but if a second hydroxyl is introduced as in dihydroxystearic acid, the detergency is decreased. The orientation of the molecule at the interface would be affected by the additional hydroxyl, tending to bend the chain towards the aqueous layer and having an unfavourable influence on the ability of the hydrophobic half to penetrate into the oily film.[26]

In the original detergents, the soaps, the hydrophilic carboxyl group was at the end of a straight chain of carbon atoms; in the simplest modification of the carboxyl, in order to obviate the sensitiveness to acids, alkaline earth salts, etc., the carboxyl was replaced by a primary alcoholic group, which was sulphonated or sulphated, the water-solubilising polar group being still at the end of the hydrocarbon chain.

Wilkes and Wickert[27] have divided surface-active compounds into 2 groups: in (1), of which the soaps, the fatty alcohol sulphates and the Igepons are examples, the polar group is a primary one, located at the end of the non-polar portion of the molecule; in (2), of which the Tergitols[27] (secondary alkyl sulphates), the Aerosols (esters of sulphosuccinic acid) and the Nekals are examples, the polar group is in a secondary position, the hydrophobic chain extending from it in two directions. The inclusion of the Igepons in (1) is of doubtful advantage, since the water-solubilising group is not present at the end of an unbroken chain of carbon atoms, but of one interrupted by a hydrophilic group. Wilkes and Wickert found that products of the first group were better detergents, but were inferior to the second group with regard to wetting power. While the first part of the conclusion is justified, it has not been possible to confirm the latter in its entirety. Examined by the interfacial tension or Herbig number methods, the secondary alkyl sulphates were not better wetting agents than the primary alkyl sulphates and Igepon T; but under prescribed conditions a recently marketed substance, having the structure of a dioctyl ester of sulphosuccinic acid, was found to give the highest Herbig number among the available wetting agents. The superior detergent power of compounds carrying the polar group at the end of the straight non-polar chain might be related to the facile adsorption of the linear chains on the cellulose macro-molecule, *i.e.*, to some factor of substantivity. At the same time, as a result of the varied and sometimes mutually opposed considerations involved in wetting and detergency, lengthening of the linear chain in order to obtain a certain favourable physical character of the aqueous solution might lead to lowering of the surface activity of the reagent on account of the tendency of the hydrocarbon residues to associate.[28] Branched chain derivatives might, therefore, have their points, as witnessed by the many patents covering possibilities in this direction. The secondary alkyl sulphates have been mentioned.

The acid sulphate ester obtained by the low temperature sulphation of 2-butyl-1-octanol has been claimed to be a good detergent (*U.S. Pat.* 2,077,005). Branched chain olefines containing at least 8 carbon atoms and one double linkage at the end of the chain are sulphonated (*U.S. Pat.* 2,061,617). Sulphation of tertiary alcohols, prepared by the interaction of vegetable oils with Grignard compounds, has been covered (*U.S. Pat.* 2,084,253). Triphenylmethane derivatives (*e.g.*, the condensation product of 2 mols. of 2-chloro-4-amylphenol with 1 mol. of benzaldehyde-2-sulphonic acid) have high capillary activity in acid, neutral and alkaline solutions (*Fr. Pat.* 816,959).

The hydrocarbon chain may be interrupted or bridged by hydrophilic groups, leading to a better balanced detergent molecule. Unsaturation, signifying unshared electrons, is hydrophilic in character. The usual hydrophilic centres in a wetting agent or detergent are derived from atoms and groups exhibiting co-ordinate covalency—nitrogen, phosphorus, sulphur, oxygen, and their combinations. Examples of subsidiary hydrophilic elements and groups utilised for bridging two hydrocarbon residues (one of which may be aromatic or alicyclic) are -O-, -S-, -SO-, $-SO_2-$, -CO-, -CO-O, -NH-, and -CO-NH-, the last, for reasons of its influence in favouring adsorption of the molecule by cellulose, being the commonest. Thus, sulphonated mixed ketones, R-CO-R', in which R is an aryl or heterocyclic radical and R' is an alkyl radical containing at least 6 carbon atoms, are detergents resistant to hard water (*U.S. Pat.* 2,089,154). Mixtures of aliphatic ketones and aromatic hydrocarbons are sulphonated to yield detergents (*U.S. Pat.* 2,081,795). Many of the synthetic possibilities in this regard have been covered by a wide patent of the I. G. (*Brit. Pat.* 479,835; 479,897) in which the products have the general formula $(A)_n$ X.B.C-, where $(A)_n$ stands for alkyl groups substituting X, an aromatic or cycloaliphatic group, B is an interrupting group (O, NH, S, etc.), and C a short alkyl chain.[28]

The most frequently employed ionogenic hydrophilic part of detergents is the sulphonic or sulphuric group. The earlier view of the undesirable nature of the carboxyl group has undergone a change[29] and among the commercial wetting agents and detergents are several containing both carboxyl and sulphonic or sulphato groups. Modification of the carboxyl by esterification or amidation using alkyl or arylamines results in a lengthening of the chain, which may be one reason for the improved wetting and detergent properties. Next in importance to sulphonate and sulphate groups as water-solubilising groups are thiosulphate, phosphate, pyrophosphate and borate groups, which are still more or less restricted to the patent literature.

Modification of the carboxyl and solubilisation of the fatty acid derivative without the introduction of strongly ionising groups, such as sulphonic and sulphuric, may be effected by the multiplication of hydroxyls; thus the partial esterification of pentaglycerol with coconut oil fatty acids yields a good detergent resistant to hard water (*Brit. Pat.* 439,435; 442,950).

Reference has been made to the recently marketed Igepals, which have excellent stability and detergent properties, and which contain no carboxyl, sulphonic or other ionogenic groups. They are soluble in water by virtue of other modifications in the aliphatic residues, and are highly polymerised compounds synthesised by systematic building up from low molecular units.

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Luminescence

VOLUME XXXV, Part I (January 1939) of the *Transactions of the Faraday Society* contains, for the most part, the proceedings of a general discussion on *Luminescence*, held under the auspices of the Society in September 1938. The subject includes all forms of emission of light by matter either on irradiation with ultra-violet or visible light, or on bombardment with X-rays or cathode rays or accompanying chemical or biochemical reactions. Altogether 28 papers bearing on different aspects of the problem and running over 238 pages are presented and discussed. The symposium has provided a forum for review and discussion of the theoretical and experimental advances made so far in this important branch of spectroscopy and the published proceedings furnish an authoritative and comprehensive reference number, especially as the list of contributors contains names of scientists who have made the subject what it is to-day. The discussion has been divided into three groups, namely, (1) luminescence of liquids and vapours; (2) luminescence of solids; and (3) chemiluminescence.

Luminescence of Liquids and Vapours

Absorption of light by matter leads, in general, to excitation of electrons associated with individual atoms or groups of atoms or radicals, to higher states of energy. This excess electronic energy may be converted to thermal or other forms of energy due to collisions of second kind, or be emitted in the form of energy of *luminescence*. When the emission of light takes place during the period of excitation the phenomenon is termed *fluorescence* and the emission after the exciting source is cut off is termed *phosphorescence*. Both fluorescence and phosphorescence co-exist and are difficult to separate spectroscopically except at very low temperatures. The simplest type of fluorescence which is easy of interpretation is the resonance radiation of mono-atomic gases and vapours. The *fluorescence-efficiency* expressed by the ratio of number of light quanta emitted to that absorbed is great in the case of these gases, provided the vapour pressure is small. The increase of pressure or the introduction of foreign gases results in mutual collisions between the excited atoms and their neighbours, which leads to *quenching* of fluorescence due to loss of energy as chemical or thermal effects. Two papers were presented on the photo-luminescence of gases by R. G. W. Norrish, and by Terenin, Vartanian and Neporent, both of which are concerned with the low fluorescence efficiency of polyatomic molecules. In these cases, due to interaction between the vibrational and rotational degrees of freedom with electronic transition, the fluorescence has a banded structure. The diffuseness in certain parts of the spectra and the total disappearance in others have been generally attributed to pre-dissociation; but Norrish points out that these effects may also be due to internal quenching of fluorescence by the internal vibrations of associated groups.

When we pass on to condensed systems, the fluorescence is no longer a rule as in gases but a rare exception. In these cases, most of the absorbed energy is converted to heat or other forms of energy. The general problems relating to the fluorescence of solutions to which E. J. Bowen refers in his introductory paper, are the efficiency of emission, spectral distribution of energy and the depolarisation. Connected with fluorescence-efficiency is the quenching of fluorescence of foreign substances and by surroundings. This problem of quenching has attracted a good deal of attention. Bowen and Norton discuss the quenching of fluorescence in solutions of anthracene dissolved in a number of solvents, at different concentrations and temperature and in the presence of various quenchers. Peter Pringsheim examines some of the explanations offered for the cause of the variation in fluorescence intensity in dye-stuffs and aromatic compounds and deals in particular with the quenching due to increase of concentration. This "concentration quenching" is explained as due to (1) collisions of second kind resulting in loss of absorbed energy as heat, and (2) the formation of non-fluorescing associated molecules. Due to its importance in sensitisation of photographic plates, the paper by Joseph Weiss on *Photosensitised Reactions and the Quenching of Fluorescence in Solution* is of great interest. The discussion following the papers leaves one the impression that the mechanism of quenching of fluorescence in liquids and solutions is far from being fully understood.

Polarisation measurements of fluorescent light in liquids and solids furnish important data leading to conclusions as to the orientation of oscillators responsible for the emission of light with respect to the length of the exciting molecule. The only paper dealing with this question is on the *Polarisation of Fluorescence of Dye-stuffs Dissolved in Meso-phases* by Zocher.

Luminescence of Solids

The scientific and commercial application of the luminescence of solids has, in recent years, given a new impetus to theoretical and experimental studies in the subject. From the theoretical point of view, luminescence in solids has been discussed briefly in an introductory paper by F. H. Spedding and in greater detail by Gurney and Mott, Frederic Seitz, C. J. Milner and N. Riehl. Two distinct types of luminescence in solids exist, namely, of pure solids and of those activated by impurities. But essentially, the fluorescence and phosphorescence in solids are associated with non-ideal crystal lattice, resulting from imperfections or distortions in the lattice brought about by heating or pressure or by the introduction of foreign impurities. Experimental evidence seems to show that the impurity atoms are distributed throughout the bulk of the parent substance. The part played by the imperfections of the lattice on the one hand, and the

impurity atoms on the other, in the re-emission of absorbed light is essentially the same. J. T. Randall has shown in his paper on *Some Recent Experiments in Luminescence* that many inorganic solids in the pure state yield fluorescence spectra at very low temperatures. It is possible that in these cases 'interstitial' metal atoms in the lattice like Zn in ZnS_n act as luminescent centres just as foreign impurities in ordinary *phosphors*. The questions that present themselves in the case of solids are, (1) what is the mechanism of absorption of energy, and (2) what is the process which results in the emission of light. Riehl believes that the energy is absorbed by the atoms of the bulk material as well as of the impurity and the absorbed energy in units called '*exciton*' wanders over without radiation to the few impurity atoms or '*activators*' and is then re-emitted. The modern theory of semi-conductors and insulators formulated by Brillouin, Wigner and Seitz offers a quantum-mechanical explanation for the process of light-emission by solids and its relation to photo-conductivity. According to this theory, the valence electrons of the component atoms in a crystalline solid exist in energy states associated with the lattice as a whole. The periodic potential field due to these electrons causes the possible transitions of electron energy to be restricted to certain bands or '*zones*' with '*forbidden regions*' lying between them. The function of the impurity atoms or imperfections in the lattice is to introduce additional energy levels in the forbidden region. The absorption of energy by an electron of the lower level leads it to go to a higher level leaving a '*hole*' behind. The excited electron may lose its excess energy as heat radiations without exhibiting any luminiscence or fall back to any of the lower states (stable or meta-stable), but not necessarily to the hole which it left behind, with the emission of radiation (luminescence). By a combination of Pauli Exclusion Principle and Frank-Condon curves, Milner gives a theoretical interpretation of the observed facts about sulphide phosphors and Seitz explains the characteristics of the alkali-halide-thallium phosphors and zinc sulphide phosphors which exhibit photo-conductivity. But the theory is by no means able to explain all the observed facts satisfactorily. Experimental observations which would be helpful for formulating a theory of sulphide phosphors are given by Levy and West in their paper. Expressions for quantum-efficiency of luminescence in solids and the laws of decay of phosphorescence in mono-molecular and bi-molecular reactions are given by Gurney and Mott. Influence of crystallisation upon the intensity and duration of luminescence in certain glasses is dealt with by Maurice Curie and a useful review of the experimental results with luminescence of inorganic solids is given by J. Ewles.

As shown by Spedding in his introductory paper, luminescence of solids yields two classes of spectra, (1) the *continuous* spectra and (2) the discrete or *line* spectra. In the light of the theory given above, if the energy states of the valence electrons are broad, either due to the influence of the neighbouring atoms or due to the thermal agitation of atoms (Debye waves) or the lattice oscillations, the spectra are continuous. Discrete spectra are given when the upper and the lower states are sharp. This condition is secured, among others, in crystals containing the elements of the transition groups and divalent manganese and trivalent chromium ions and in organic compounds containing unsaturated resonating bonds. Lowering temperature simplifies the spectra in all cases and renders the continuous spectra generally sharp. From the papers presented and the discussions, it is clear that there is much scope for further experimental work by employing low temperatures and single crystals. The influence of lattice oscillations and molecular vibrations and rotations on the position and distribution of intensity in the spectra remains to be worked out.

In a very interesting paper on the *Application of Phosphorescence Spectra to the Investigation of the Structure of Solids and Solutions*, R. Tomaschek outlines a new method of investigation of (1) the structure of glasses, (2) the nature of phosphorescent centres, (3) the hyperstructure of crystals and (4) the constitution of liquid solutions. The method consists in embedding ions of Cr, Ni, or Co or the rare earths in solids which otherwise yield continuous spectra and in analysing the resulting line spectra in terms of the energy scheme for the activator. Further development of the method promises to yield valuable information regarding the nature of forces in the solid and the liquid media. The technical importance of investigations in luminescence in solids is shown by papers dealing with fluorescence efficiency of discharge tubes containing neon by Jenkins and Bowtell, with cando-luminescence by Minchin and with the practical application of luminiscent solids for the manufacture of high lumen-efficiency mercury discharge lamps and of decorative signs and for the preparation of luminescent screens for television by T. J. Davies. Developments of commercial value in illumination engineering may be expected to arise out of researches in this direction in the near future.

Chemi-Luminescence

As in the luminescence of solids and liquids, the emission of light accompanying certain chemical reactions is explained as due to the production of excited ions, ionic complexes, or radicals during intermediate reactions, and consequent emission of photons. The explanation of different stages of chemical reactions involved varies from system to system and in fact, the spectral study of the emitted light yields important information regarding the kinetics of those reactions. The papers, dealing as they do with individual systems, are necessarily incoherent and cannot be brought under one common principle. The paper by R. Audubert contains interesting new observations on the *Emission of Ultraviolet Rays by Chemical Reactions*, which would be of help in future investigations of molecular transformations during chemical changes. The paper on Bioluminescence by Harvey gives a brief review of the theories advanced in explaining the

mechanism of production of light of high quantum efficiency by living matter.

In conclusion it may be stated that the contributions made in the Symposium and the lively discussions accompanying them show that while luminescence is a fundamental phenomenon and much has been done in the way of exploration, there is much more which awaits further investigation, both theoretically and experimentally, before a general theory of luminescence explaining all facts connected therewith could be formulated. By bringing together prominent workers in the field and publishing the proceedings in full, the Faraday Society has done a great service for the future workers in the subject.

C. S. VENKATESWARAN.

Einstein's Generalisation of Kaluza's Unitary Theory

THE Kaluza-Klein theory introduces a fifth dimension in attempting to derive a unitary theory connecting gravitation and electricity. Einstein has recently attempted to generalise this theory[1] by putting in physical concepts into the purely mathematical structure of Kaluza's theory.

The aim of this theory of Kaluza was to obtain some new physical aspect for gravitation and electricity by introducing a unitary field structure with the aid of a fifth dimension, the essential result being that such a five-dimensional structure could be built up so as to be equivalent to a four-dimensional structure *plus* a vector field which is the potential vector for the electro-magnetic field. This result, though elegant mathematically, was not productive of new physical ideas, and consequently many attempts were made to retain the essential formal results obtained by Kaluza without sacrificing the four-dimensional character of the physical space. But all such attempts have proved unproductive, and it appears impossible to formulate Kaluza's idea in a simple way without introducing the fifth dimension.

On the basis of these considerations, Einstein and Bergmann have now attempted to introduce the fifth dimension in a very effective manner without its being merely a sort of "catalytic agent" as in the Kaluza theory. To bring out clearly the generalisation proposed by Einstein, let us consider how Kaluza's five-dimensional structure is made equivalent to a four-dimensional one and a vector field. It can be shown that by a suitable characterisation of the 5-space with the metric

$$d\sigma^2 = \gamma_{\mu\nu}\, dx^\mu\, dx^\nu \quad (\mu, \nu = 0, 1, 2, 3, 4) \ldots (1)$$

the components of the fundamental metric tensor can, by the choice of a special co-ordinate system, be reduced to ten functions g_{mn} and the four functions A_m $(m, n = 1, 2, 3, 4)$ *which do not depend on* x^0. This reduction gives a four-dimensional description of the space, and the independence of the functions on x^0 shows the purely formal nature of the fifth dimension x^0 which is just put in only to be taken out later. On Einstein's new theory it is shown that, with a suitable modification of the postulates of the 5-space, it is possible to make an exactly analogous reduction to g_{mn} and A_m with this difference that the *components of* g_{mn} *are in general periodic functions of* x^0. The A_m, however, is independent of x^0 as in the old theory. Remembering that g_{mn} is a four-dimensional metric tensor, this amounts to an intimate physical connection of the space-time with the new dimension. The x^0 which is put in at first is not taken out after the reduction but left behind so as to modify the 4-metric. The periodicity of the components of this 4-tensor in the new co-ordinate enables one to interpret physically the fifth dimension. In a very rough way, one could describe this as a sort of a *phase*, and the *4-dimensional space-time* might be thought of as having been replaced by a *5-dimensional space-time-phase*. Since, however, this new co-ordinate is "dimensionless" there arises no contradiction with the empirical four-dimensional character of physical space.

From its very nature, the new theory is essentially complex in its physical aspects, and Einstein and Bergmann have given the derivation of the fourteen field equations starting from a variational principle, and also the identities satisfied by the field equations. The theory involves four universal constants of which one corresponds to the gravitational constant involving a connection between the units of length and mass, another depending on the unit of length, while the remaining two are "genuine" universal constants which cannot be eliminated from the theory.

When looked at from the purely geometrical point of view the new theory introduces some very interesting features. The five-dimensional space defined by the metric (1) is here closed with respect to one dimension, and this closed space will be represented by a space which is open and periodic with respect to this dimension. A point P of the physical space will be represented by an infinite number of points P, P', P" of the 5-space. This type of non-homeomorphic correspondence between general metric spaces is itself a rich mathematical concept capable of a large number of developments.

B. S. MADHAVA RAO.

[1] Vide *Annals of Mathematics*, July 1938, **39**, No. 3, 683.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(University Librarian, Madras)

Dale, Samuel (1659–1739)

SAMUEL DALE, a British botanist and physician, was apprenticed for eight years to an apothecary, and he established independent practice, about 1688. His critical knowledge of plants and drugs was acknowledged by eminent scientists of his day.

Contributions to Medicine

His chief work was the *Pharmacologia or an introduction to the materia medica* (1693) which went through several editions even long after Dale's death. It was the first systematic work of importance on the subject.

Contributions to National Science

His second great work took the form of an appendix to the second edition (1730) of Silas Taylor's *History and antiquities of Harwich and Dovencourt*. He built up a herbarium of great value. He bequeathed this to the Apothecaries' Company and it is still preserved in the British Museum.

Genus *Dalea*

Nine of his papers were published in the *Philosophical transactions* of the Royal Society. His services to Botany made Linnaeus immortalise his name in the leguminous *Dalea*.

Dale died June 6, 1739.

Cunningham, Allen (1791–1839)

ALLEN CUNNINGHAM, an Australian botanist, was born at Wimbledon, Surrey, on July 13, 1791. He was educated at Putney and trained for the law by a Lincoln's Inn conveyancer. Finding these studies uncongenial, he became assistant to Acton, the manager of Kew Gardens. In 1814 he was appointed Botanical Collector to the Royal Gardens. Having spent two years in Brazil, he reached New South Wales in 1816. He spent the next sixteen years in explorations and botanical researches, having been attached to P. P. King's survey party from 1817 to 1822.

His Publications

His notes on the botanical results of the survey occupy nearly 40 pages of King's *Narrative of a survey*. It was considered important enough to be issued separately in German as *Einige allgemeine Bemurkgen uber die Vegetation, vorzuglich der Nordwestkuste von Australien* (1829). Six other papers of Cunningham were published in different periodicals.

As Colonial Botanist

Having spent about four years in England to arrange and name his specimens at Kew, he succeeded his brother in 1835 as Colonial Botanist; but he resigned in 1837 as he found that his duties included too much uncongenial work and actual gardening, the government officials having formed the habit of procuring their supply of vegetables from the botanical garden. But the Governor was anxious to retain his services and ordered the abolition of the "Cabbage Garden" practice. But Cunningham demanded the position of government botanist, with no responsibility for the botanical gardens and *carte blanche* as to the disposal of his time. As it was felt that the last condition might prove a dangerous precedent, he was offered as an alternative, six months' leave every year to prosecute explorations. But the negotiations fell through and Cunningham went away to botanise in New Zealand, from where he returned to Sydney in a deplorable state of health and died, June 27, 1839.

Bell, Horace (1839–1903)

HORACE BELL, a British Indian engineer, was born in London, June 17, 1839. Having received his early education in France and at Louth in Lincolnshire, at the age fifteen, he was placed as a pupil with a civil engineer in Westminster. But recognising, even at that age, the need of thorough grounding in the profession he wished to follow, he went to Glasgow where he entered the firm of Messrs. D. Cook & Co., as an apprentice. Afterwards he worked in Caledonian Railway shops. In 1859 he got employed in London. Three years later, he was successful in open competition for an appointment as an assistant engineer in the Indian Public Works Department.

As Indian Engineer

He was posted, in the first instance, to the Central Provinces, where he worked on the construction of the Grant Deccan Road connecting Calcutta and Bombay. In 1870 he was sent on railway survey work to the Wardha valley and successively worked in the construction of several railways such as Indore (1870), Punjab Northern (1874), Rajputana (1875), Neemuch (1878), Great Western and the Moghul-Serai Railways.

Nilgiri Mountain Railway

On retirement, he established himself as a consulting engineer in London and as such, he guided the design and construction of the Nilgiri Mountain Railway, a rack railway of meter gauge, opened in 1899.

Bell died in London, April 10, 1903.

ASTRONOMICAL NOTES

Planets during July 1939.—Mercury will be an evening star and on July 14, will be at its greatest eastern elongation from the Sun (− 26° 31′). Venus continues to draw closer to the Sun and will be visible only for a very short time before sunrise. Mars is best situated for observation, being in opposition to the Sun on July 23; its semi-diameter at the time will be 24″ and the stellar magnitude − 2·6 (nearly two and a half times brighter than Sirius). The planet is closest to the earth on July 28 when the distance will be about 36 million miles.

Jupiter rises a little before midnight and will be a conspicuous object in the eastern sky during the latter part of the night. On July 30, it will be at a stationary point of its apparent orbit. Saturn will be in quadrature with the Sun on July 24 and will be found near the meridian at sunrise. The ring ellipse is getting gradually wider, the major and minor axes being 40″ and 11″ respectively on July 15. Uranus is slowly moving eastwards in the constellation Aries and can be seen as a morning star. There will be a close conjunction of the planet with the Moon on July 12. An occultation of some interest that can be observed in India is that of α Libræ (magnitude 2·9) by the Moon on the night of July 24.

Comets.—Pons Winnecke Comet is still faint and is moving towards the south in the constellation Böötes. According to the computations of Levin and Porter, the Comet will be nearest the earth on July 2 when the distance will be about ten million miles. At the apparition of 1927, the Comet approached the earth to a distance of four million miles when it was conspicuously visible to the naked eye. Although it may not reach the same brightness next month, it is very likely the Comet will become bright enough to be seen with some moderate optical aid.

The bright Comet (1939 *d*) which was discovered on April 18, was visible to the naked eye for a considerable time and has been widely observed. It has since moved southwards into the constellation Canis Minor and has become fainter.

T. P. B.

SCIENCE NOTES AND NEWS

A New Method of Creating Electrification.—When certain insulating materials, *e.g.*, silica, sulphur, in an adequate degree of fineness are allowed to strike a metal plate perforated with small holes, the metal plate becomes electrified positively and the insulating powder negatively. In order to produce the effect the materials must be dry and the size of the grains of the powder must be such that when they fall on the perforated metal sheet, they fall through and do not accumulate on the metal. This novel phenomenon recently discovered by A. Flemming (*Proc. Phys. Soc.*, 1939, 51, 401) is shown to be inexplicable in terms of frictional or piezo-electric effects, and forms the starting point of a new and fruitful line of investigation.

K. S. G. D.

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Bud Mutations in the Orange.—An extraordinarily interesting instance of bud mutation is to be found in the case of the Satsuma Orange (Unshiu), *Citrus unshiu*, Marc. var. *præcox* of the variety called Wase. This variety has the peculiar characteristic that it does not breed true from vegetative propagation. These trees often send out single branches of entirely different character from the main type of branches on the tree. In some trees the variation branch is not limited to a single branch per tree but that two or even three arise from a single tree. These bud mutations show the most diverse variations. Some are suited to hot climates; some are resistant to insufficient care; some produce gigantic fruits; some give fruits which are globose, and others flat-topped fruits; some again are found to suit even very cold climates; some give exceedingly early-maturing fruits of excellent quality. It is stated that quite fifty different mutants have been so far observed in this variety of orange. The discovery of this phenomenon has been fully exploited by the Japanese in extending their areas of orange cultivation and in raising fruit which can come into the American market long before the local crop. Prof. Tanaka, the famous authority on oranges, who draws attention to this interesting subject (*The Philippine Agriculturist*, 27, No. 6) refers to the great difficulty of explaining scientifically this problem of the unstability of the Wase variety of the Satsuma Orange and after discussing various possibilities, inclines to the opinion that the change may be the result of external factors like a strong stimulus, as a wound or a break, or unusual accumulation of nutrients by girdling or twisting. He states his observation that the mutating branches have distinct signs of disturbance close to the point from which the mutation started. If this view is correct, then it should be very easy to induce mutations artificially wherever desired.

A. K. Y.

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The Effect of Scion on Stock.—Describing the progress of horticultural research in Japan, Prof. Tanaka draws attention to what is well known to Japanese pomologists, though not so well known outside, *viz.*, the marked change undergone by the citrus stock *Poncirus trifoliata*, the trifoliate orange, which is the stock used extensively in Japan for the propagation of the orange (*The Philippine Agriculturist*, 27, No. 6). The trifolate orange plant

is a shrub in nature but when it is used as a rootstock it swells up greatly in size, becoming thicker than the scion when the latter assumes an enormous size. Prof. Tanaka studied the results of budding citrus varieties of many kinds on to trifoliate rootstock and found that the rootstock undergoes remarkable change, showing a different amount of growth exactly in accordance with the scion species. With scion of sweet orange, for instance, the trifoliate stock becomes deep-rooted; with the lemon as scion, the opposite effect is produced on the trifoliate rootstock, *viz.*, a shallow root system, and even a change in the colour of the roots. The same result of changing the character of the root system of the stock has been found, he says, in the Japanese *Persimmon Diospyros* Kaki, and in other fruits. Some varieties always give the roots a narrow angle or a deep-rooting habit to the rootstock while others give a shallow-rooting habit. In the case of the apple, the *Famuse* apple in California is stated to give a deep-rooting habit and the *Akin* apple a shallow-rooting habit to the rootstock.

A. K. Y.

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The Absorption of Ammonium Nitrogen by Plants.—That pineapple plants can absorb and assimilate ammonium nitrogen and that they can do so more readily than nitrate nitrogen when grown in nutrient solutions, is shown by water culture experiments, reported by C. P. Sideris *et al* (*Plant Physiology*, 1938, 13). The immediate products of the assimilation by the roots were amino-acids and small quantities of glutamine and asparagine. Nitrate was assimilated very slowly if at all in the root tissues and was translocated through the stem and non-chlorophyllous tissues of the leaf bases presumably to the chlorophyllous tissues. Nitrate nitrogen was neither absorbed nor assimilated as readily as ammonium nitrogen, which was apparently assimilated in the roots as readily as absorbed. Plants in the ammonium series contained in the non-chlorophyllous tissues comparatively great amounts of soluble organic nitrogen and small quantities of protein; whereas the plants in the nitrate group had in their roots large quantities of protein as compared with organic soluble organic nitrogen. The nitrate group also showed a lower rate of carbohydrate utilisation as evidenced by the presence in their leaves of somewhat greater amounts of reducing sugars and sucrose.

A. K. Y.

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The Golgi Apparatus in Amphibian Tissue Cells.— An important contribution to our knowledge of the structure of the Golgi apparatus of vertebrates is made by A. W. Pollister (*Quart. Journ. Micros. Sci.*, March 1939, 81, Pt. II). He has examined practically every tissue cell of Amphibia and is able to formulate certain general conclusions regarding the structure and arrangement of the Golgi apparatus in this group. Larvæ as well as adults have been examined. Regarding the arrangement of the Golgi apparatus and the associated parts in the cell he notes two types: (1) the epithelial or physiologically polarised type where the Golgi apparatus is in the form of a collar surrounding the nucleus and with the centrioles far distant from the Golgi apparatus; (2) the leucocyte or physiologically the unpolarised type where the Golgi apparatus is in the form of a horizontal collar in close relationship with the centrioles. Regarding the structure, two facts appear to be emphasised by the author: (1) Everywhere and in every kind of tissue cell of Amphibia the Golgi apparatus is lamellar and presents some variation of a plate-like structure resembling the condition found among the invertebrata; (2) In the Amphibia, at any rate, no differentiation between osmiophilic and osmiophobic regions can be made out in the Golgi apparatus.

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A Gigantic Monument in India.—A new chapter has been added to the artistic and cultural history of Bengal in the publication, just made, in the series of *Memoirs of the Archæological Survey of India*, of a monograph on the results of the excavations at Paharpur, Bengal.

The Paharpur mound and its enclosure were protected by the Archæological Department nearly twenty years ago, and the first sod was turned sixteen years ago. The systematic excavation by the Archæological Department begun in 1925 was only recently concluded, and the place has now revealed a great four-storeyed temple with a unique plan and a gigantic monastery containing nearly 190 cells enclosing it.

The plan of the main temple at Paharpur consisting, as it does, of a square shrine in the centre with cross-shaped adjuncts on each side and projections between each side, the whole being constructed in four terraces, is so far unique in India and supplies the missing clue to the type of architecture so prevalent in Burma, Java and the Malayan Archipelago. After the discovery of Paharpur an earlier prototype has been found farther inland at Nandangarh in the extreme north of Bihar.

The most important discoveries at Paharpur are the stone images in the lower basement of the main temple, which revealed a new school of art in the sixth–seventh century A.D. It is astonishing that in a monument which, there is no doubt, must be identified as the Buddhist *vihara* built by the well-known Pala Emperor, Dharmapala, at the end of the eighth century A.D., such a remarkable series of sculptures consisting mainly of Brahmanical figures should have been found embedded in the walls in such good preservation.

The most numerous specimens of artistic work found at Paharpur are the terracotta plaques, of which nearly 2,800 were found, over two-thirds being still *in situ*. These plaques in which are depicted a bewildering variety of subjects play a prominent part in the scheme of decoration of the walls in each terrace of the temple, there being two or even three rows of plaques in some walls.

* * *

The Bihar Earthquake of 1934.—Extensive investigations have recently been made on the nature of the numerous earth fissures which came into existence all over the affected area, as a result of the great Bihar earthquake of 1934. The fissures were widespread over certain zones north of the Ganges, and generally

followed pronounced surface features such as river-banks, lakes, tanks, road and railway embankments, etc. Sometimes they were arranged in a series of step faults, others resembled trough faults where the ground sank between two parallel fissures. The maximum width of a fissure was about 27 ft. and the greatest length, 700 yards. Towards the end of the main shock, and immediately after it, enormous quantities of sand and water were thrown out from vents and fissures. The fact that the erupted water was frequently reported to have been hot shows that it may have come from a fair depth.

The fearful rumblings which accompanied the earthquake have also been investigated and these have been variously described as comparable with the noise of "several aeroplanes", "a heavy motor lorry", "an approaching goods train", "a passing motor car", or "a train passing through a tunnel". So far as can be judged, these sounds were heard more or less simultaneously over the whole area, and could not accordingly have originated from a point. During the transmission of seismic waves, rock particles are moving rapidly against each other, and the secondary vibrations so set up may give rise to sound waves. The sounds emitted are independent of the speed of the seismic waves, but are indirectly dependent upon their frequency.

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Earthquake Shocks in 1938.—According to the General Report of the Geological Survey of India for 1938, Htawgaw, not far from the China frontier in the northern corner of Burma, maintained its notoriety as one of the most seismic places in this country, by recording several scores of shocks.

A series of tremors and shocks of varying intensity, accompanied by loud rumbling sounds, were felt in Western India at Paliyad. The shocks are ascribed to changes taking place beneath the Deccan trap formation of the locality, probably connected with the uplift of Kathiawar in recent geological times, which in places amounts to about 1,200 feet.

Occasional shocks of small intensity continued at Mettur in the Salem District where the Cauvery River has been impounded by a large dam having a miximum depth of storage of 165 feet and a net capacity of 93,500 million cubic feet of water.

Many shocks of light to moderate intensity were reported from north-western India, the Punjab, Kashmir, North-West Frontier Province and Baluchistan. One of these, of moderate intensity sufficient to affect persons at rest and make hanging objects swing was felt between 15·00 hours and 15·05 hours I.S.T. on January 18, 1938, over a large area north and west of Lahore. No damage to property was reported. Two other shocks of a similar nature, one at about 16·15 hours on January 26 and the other at about 1·00 hour on February 15, were also felt in several places in the North-West Frontier Province.

A number of tremors and light shocks were felt in Assam, in and around the plateau.

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Andamans' Shell Fishery.—Indications of a new industry, the possibilities of which yet remain to be exploited by India, are given by the Zoological Survey of India, as a result of investigations lately concluded on the shell fishery of the Andamans and Nicobar Islands.

Round these reef-bound islands of the Bay of Bengal, there occur beds of two large species of marine snails, the Top-Shell and the Turban-Shell of commerce known to zoologists as *Trochus niloticus* and *Turbo marmoratus*. The shells of the snails, as well as those of the pearl-oysters and similar animals, are largely used in China, Japan, the Philippines and other parts of the world for inlaying and other forms of ornamental work and in the manufacture of buttons, studs, tooth powder, etc. The best grades of shells are sold at Rs. 600 to Rs. 800 per ton in the Singapore shell market. Between 1930 and 1937, the shells fished under licence in the Andamans and Nicobar areas exceeded 1,200 tons, valued at Rs. 8,50,000.

Little was known of the occurrence, life-history, growth and bionomics of the shell fish, and as rules and regulations to control the fishery had to be based on facts relating to the life of the animal, the Zoological Survey of India was called upon to undertake a preliminary study of the fishery in 1930, when the fishing by enterprising Japanese Fishery Companies had been in progress for three months.

With the help of a small research staff at Port Blair, Andamans, drafted from the Zoological Survey of India and under the control and direction of the Director of the Survey, some important facts concerning the life-history of the shell fish and the fishery were gathered during the six years 1930–35. These facts are now published in the form of a "Consolidated Report on the Shell-fisheries in the Andamans".

As a commercial proposition, the shell-fishery has suffered a setback mainly as a result of excessive fishing in the earlier period, both by the licensed and the unlicensed Japanese fishermen of Singapore, which has considerably thinned out the shell population of the sea. The indiscriminate removal of all shells, whether young or in the breeding stage, has likewise been the cause of the decline of the shell population.

The enforcement of the observance of the rules and regulations framed for the protection of the fishery was by no means easy. The result has been that shell-fishery in the Andamans has been at a low ebb for the last five years and it seems that nothing can rehabilitate it except prolonged rest from fishing for a period from three to five years.

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Dipterocarpus (Gurjan) Forests in India and their Regeneration.—A recent publication issued by the Forest Research Institute, Dehra Dun (*Indian Forest Records*, 3, No. 4) summarises all available information concerning the *Dipterocarpus*, which are extensively employed for railway sleepers, plywood and for general constructional purposes. Nine species of *Dipterocarpus* are known, all of which are considered to be good, general utility timbers. The trees are usually of large size and give a high outturn of sound, clean timber of uniform quality.

The publication, besides containing information on the distribution and silvicultural characters, gives details regarding the natural and artificial methods of regenerating these species.

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The Hornet's Nest placede on show in the Insect Gallery of the Indian Museum, Calcutta, is probably one of the largest specimens that have yet come to notice, it is a never-ending source of interest to the visiting public, who are able to examine at close quarters and in perfect safety its complicated internal structure.

The nest was acquired by the Zoological Survey of India from a small *bael* tree growing in the compound of a house in Calcutta in 1925. On enquiry it was found that the hornets commenced building this beautiful nest in the spring of 1924. In the month of March the size of the nest was about the size of the *bael* fruit and by May it had attained the size of a man's head; towards the end of October the growth of the nest reached its maximum and was over 3½ feet in height, its maximum breadth near the base being over 2 feet.

The nest is covered over by an envelope of a papery material which is probably a mixture of chewed wood and some glandular secretion of the hornets; usually the covering is thin and delicate but in the present case it is very strong and tough. The envelope completely encloses the nest, except for two small circular openings on the two sides near the base, which served as the ingress and exit passages to the nest.

Vespa cincta, which is the name by which this insect is known to the scientific world, is a fairly common species of hornet found all over the plains of India. It builds its nests in the holes of large fig and other forest trees. It is largely predacious and its larvæ are known to feed on other insects. Although at times it causes injury to fruits, it is useful as scavenger and in reducing the number of other insects, more especially Dipterous and Lepidopterous larvæ which are responsible for the destruction of several economically important plants.

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A new giant telescope has recently been installed at the **McDonald Observatory** in Davis Mountains of Western Texas. The instrument has a 82-inch mirror and is capable of photographing stars only a millionth as bright as any that can be seen by the unaided human eye. This brings the total number of telescopes of 2 feet in diameter or more now in use in the world to 40. According to a Bulletin recently issued by the *National Geographic Society*, "The McDonald Observatory telescope is the second largest in the world in actual use at present, being exceeded only by the 100-inch telescope at Mount Wilson Observatory, Pasadena, California. Both, however, will be surpassed soon by the 200-inch telescope to be set up on Mount Palomar, California, under the joint auspices of California Institute of Technology and Mount Wilson Observatory. The McDonald Observatory will be operated jointly by the Universities of Texas and Chicago. The mirror of the McDonald Observatory telescope weighs nearly three tons, yet its curved surface has been ground and polished to an accuracy of one-millionth of an inch. The telescope and its mounting weighs 75 tons, yet it is so perfectly balanced that it is moved by a motor of 1/3 H.P. and can be adjusted to a hair's breadth."

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Demographic Problems.—The League of Nations' Committee of Experts, whose terms of reference were "to study demographic problems and especially their connection with the economic, financial and social situation and to submit a report on the subject which may be of practical value to Governments in the determination of their policies", held its first session recently, with Prof. T. Smolenski as Chairman. According to a communique issued by the Information Section of the League of Nations, the Committee held a general discussion with the object of defining the points to which its studies should, in the first place, relate. The following three questions will receive attention at the beginning: (1) the problems which present themselves in countries with rapidly increasing populations; (2) the problems which present themselves in countries with or threatened with diminishing population and (3) the problems which present themselves in countries with a population which is small relatively to the productive area or to the natural resources. The Committee also considered the advisability of organising a demographic centre attached to the Secretariat.

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Anti-Malarial Drugs.—The enormous disproportion between the world output of quinine and the quantity required to treat known cases of malaria is widely recognised. The latest issue of the *Chronicle of the Health Organisation* of the League of Nations (Vol. I, No. 6) refers to this question and points out that "this matter is the more deserving of attention as malaria-ridden countries are usually countries of limited economic resources and are unable for that reason to meet the expense of collective treatment and prophylaxis by anti-malarial drugs".

The Malaria Commission has carried out extensive comparative experimental work on the so-called synthetic drugs. The research work conducted by the Commission has enabled it to recommend the use of *totaquina*, a mixture of cinchona bark alkaloids, that can be produced at a price well below that of quinine.

With a view to consider the present state of production of anti-malarial drugs in various countries, the requirements of malarious countries and future possibilities and to consider how the consumption of these drugs can be promoted, the Health Organisation of the League of Nations, on the recommendation of the Malarial Commission, proposes to call for a conference of representatives of producing and consuming countries; the conference will probably be held in 1940.

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Microbiology in the Preservation of the Hen's Egg.—When eggs are stored all possible steps must be taken to prevent their spoilage by moulds and bacteria. A recent report issued by the Food Investigation Board (*Special Report*, No. 47. H. M. Stationery Office. Price 2*sh.* 6d.) deals *inter alia*, with the various kinds

of micro-organisms that attack the egg, the sources from which they come, the types of spoilage they cause, the egg's defences against invasion, and the means that can be adopted in storing eggs to reduce infection and consequent spoilage.

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The **Simphak** or Bark cloth of the Garos of Assam, was one of the exhibits shown by Dr. B. S. Guha at the ordinary monthly meeting of the *Royal Asiatic Society of Bengal* held on the 5th June. "The making and use of bark cloth is confined to the Matchi and Chisak Garos inhabiting the eastern half of the district. They call it *Simphak* and prepare it from the bark of one of the following trees: (1) Pakram (*Grewia liliæ folia*), (2) Prap (*ficus Rumphi*), (3) Chram (*Artocarpus Chaplosha*), (4) Dumbri (*ficus glomorata*), (5) Anisep (*Kydia calycina*). Of these the first yields the best and the last, the worst kind of *Simphak*. The bark is taken from the main stem of the trees by cutting two rings on the stem about 8' apart. These are joined by one vertical cut and the bark is split open and pulled off. The outer green layer is carefully removed and the bark is well pounded from the one end to the other running along the fibre with serrated mallet on a smooth log of wood. It is then doubled over lengthwise and the process of folding and pounding is continued until it is reduced to a thick mass of fibre. The moisture is wrung out and it is dried in the sun unfolded. The requisite length and width are obtained by stitching together two or three pieces, the usual size being 8' × 2'. The *Simphak* is used for blanket or bedding purposes and is never used for wearing by the Garos."

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The *Annual Report* of the **Indian Association for the Cultivation of Science** for the year 1938 refers, briefly, to the more important activities during the past year. Sir Arthur Hill delivered the Ripon Professorship lectures for 1938, Prof. J. E. Lennard Jones, the Coochbehar Professorship lectures, and Sir L. L. Fermor, the Ripon Professorship lectures for 1937. The Joy Kissen Mookherjee Gold Medals for the years 1937 and 1938 were awarded to Sir James Jeans and Dr. F. W. Aston. Seven scholarships were awarded during the year. Thirty-nine papers covering 462 pages were published in the *Indian Journal of Physics*, the contributions being drawn from various parts of the country. Important research work was carried out under the direction of Professor K. S. Krishnan, Mahendralal Sircar Professor of Physics; these researches are classified under the following heads: (1) Paramagnetic studies on single crystals at low temperatures, (2) Magnetic behaviour of manganous salts, (3) Magnetic anisotropy of hydrated gadolinium sulphate, (4) Magne-crystallic studies in relation to valency problems, (5) Crystalline fields in rare earth salts, (6) Magnetic studies in relation to crystal structure, (7) Some theoretical implications of the magne-crystallic work and (8) Magnetic studies on organic crystals. Dr. S. C. Deb, Research Fellow, carried out investigations on the absorption spectra of sulphides and sulphur molecule.

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The Mining, Geological and Metallurgical Institute of India.—The latest number of the *Transactions of the Mining, Geological and Metallurgical Institute of India* (May 1939, 35, Pt. 1) gives the Proceedings of the Annual General Meeting of the Institute held on 13th January 1939, at which Mr. A. Farquhar was elected President of the Institute for the ensuing year. Mr. Farquhar's Presidential Address deals with the factors governing the conservation of the natural mineral resources of the country—especially of the coking coals of India. He deals with the various aspects of this problem, such as stowing of coal by packing, co-ordinated sequence of working the coal seams, blending of coals, washing of coals, rationalisation of coal production and coal consumption, research, etc., and in this connection, discusses the several recommendations of the Coal Mining Committee. In Mr. Farquhar's opinion, "the most pressing need to-day, therefore, is the formation of a National Industrial Research Board to make an immediate investigation into these questions, and definitely and finally establish a condition of affairs which will meet, with safety, the needs of the country, both for the present and the future."

The issue also contains a very elaborate and valuable paper by Mr. J. Thomas on "Methods of Stowing for Indian Mines" which, together with the views expressed by the leading workers on this subject in the course of the discussion following the paper, will form an outstanding contribution to the study of this problem of great importance in the Coal Mining Industry in India at the present day.

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A recent Press Note issued by the **Indian Central Cotton Committee** gives a resume of the work on cotton carried out at the *Institute of Plant Industry*, Indore, since its inception in 1924. In 1932, the Committee reviewed its policy with regard to the work of the Institute and approved of a revised programme which included, besides different field experiments dealing with agronomic problems, (*a*) botanical classification and survey, (*b*) cotton breeding and selection, (*c*) cotton genetics, (*d*) physiology of the cotton plant, (*e*) influence of environmental factors on lint characters, and (*f*) field experimental technique. Considerable progress has been achieved in all these directions. A satisfactory classification of Asiatic cottons, complete and acceptable to taxonomists, has been published. A census study of the cotton crops in Central India and Rajputana has shown that the best yielding cotton is a balanced mixture of types and not a pure type. The mode of inheritance of quantitative characters in cotton is being intensively studied at the Institute, and a new technique has been developed to overcome the difficulty of environmental variation and for distinguishing it from genetic variation. Varietal trials have given results of great practical value and through seed-distributing organisations, the purity of new strains has been effectively maintained, thus ensuring the best monetary return to the cultivator. The Institute also provides training in various branches of cotton research to students selected by the Indian Central Cotton Committee.

A report on the **staple length of cotton** produced in India for the 1938–39 season has just been published.

The total production of cotton for the season is estimated at 5,120,000 bales of 400 lbs. each, the trade estimate being higher, *i.e.*, 5,979,000 bales (including a figure of 450,000 bales representing extra-factory consumption); of this it is estimated that 5 per cent. was of staple length 1" and over 32 per cent. of staple length 7/8" to 31/32". The corresponding percentages for the previous years were 4 and 27 respectively, showing thereby an increase in long and medium staple cotton production in India.

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Birthday Honours.—The Honours List issued on the 8th June, contains the following names of scientists:—

C.I.E.: Mr. H. R. Stewart, Director of Agriculture, Punjab; Mr. W. J. Jenkins, Officiating Director of Agriculture, Bombay; Lieut.-Col. F. T. Anderson, Professor of Surgery, Medical College, Calcutta. **O.B.E.**: Mr. E. J. Bruen, Live-Stock Expert to the Government of Bombay. **M.B.E.**: Mr. A. F. MacCullough, Advisory Chemist, Medical Stores Department, Madras. **Rao Bahadur**: Rao Sahib D. V. Bal, Agricultural Chemist to the Government of the C.P. and Berar; Rao Sahib S. L. Tambe, Special Officer for the Improvement of Cotton and Member of the Legislative Council, Indore State. **Rai Sahib**: Dr. Piare Lal Srivastava, Reader in Mathematics, Allahabad University, U.P., Babu Sajani Kumar Chatterji, Officer-in-Charge, Bacteriological Laboratory, Patna, Bihar.

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Lady Tata Memorial Trust.—The Trustees have announced the awards of the following scholarships and grants for the year 1939–40:—

(1) *International Awards*: Dr. Jorgen Bichel (Aarhus, Denmark), Dr. Julius Engelbreth Holm (Copenhagen), Dr. Maurice Paul Jean Guerin (Paris), Professor Dr. Karl Jarmai (Budapest), Professor J. McIntosh (London), Professor Eugene L. Opie and Dr. Jacob Furth (New York), Dr. Joachim Wienbeck (Breslau), Dr. Werner Jacobson (Cambridge), and Dr. Edorado Storti (Pavia, Italy).

(2) *Indian Scholarships*: Mr. K. Ganapathi (Bangalore), Mr. M. Sadashiva Rao (Bombay), Mr. T. J. Job (Calcutta), Mr. M. K. Halder (Dacca) and Mr. P. L. Narasinha Rao (Bangalore).

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Dr. K. N. Kaul, Lucknow University, has been appointed as a member of the staff of the Royal Botanic Gardens, Kew.

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Dr. W. L. Davies, Research Dairy Chemist and Analyst, National Institute for Research in Dairying, Shinfield, near Reading, has been appointed Director of the Imperial Dairy Research Institute.

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Dairy Science Abstracts.—The Imperial Bureau of Dairy Science will shortly publish a quarterly journal called *Dairy Science Abstracts*, the purpose of which will be to provide a survey in English of the current literature of dairy science from all parts of the world. The Table of Contents will include (1) Husbandry, (2) Technology, (3) Control and Standards, (4) Economics, (5) Physiology, (6) Bacteriology and Mycology and (7) Chemistry and Physics. At present this literature is published in a variety of languages and scattered in a large number of journals, many of which are not generally available to workers in dairy science. Particular attention, therefore, will be paid to information published in less familiar languages or in journals with a limited distribution.

The first number will deal with literature received or examined by the Bureau during January, February and March 1939. A number will appear every three months; four numbers will constitute a volume. To facilitate reference each number will contain an author index, and each volume, author and subject indexes.

The annual subscription, inclusive of postage, will be:—For residents of the countries of the British Commonwealth and the Anglo-Egyptian Sudan who send their subscriptions direct to the Bureau, 20/-. For all other subscribers, 25/-. Single parts, each, 7/6.

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Spectrographic Analysis in Great Britain.—Edited by A. C. Candler (Adam Hilger Ltd., London), 1939. 80 Pp., limp cloth covers: 7*s.* 6*d.* net; 7*s.* 9*d.* post free.

Although specialised spectrographs for use in industry originated in Great Britain and are widely used here, the fact has received relatively little notice in scientific or other publications.

This record of the uses to which the spectrograph is being put in 28 British factories and research laboratories may therefore come as a surprise to many who still regard chemical analysis as the only method of determining the elements present.

The applications are extremely diverse. About half the contributions deal with the analysis of metals and alloys and these show that analysis by the spectrograph is accurate enough to replace chemical analysis for the routine control of many alloys, while where a factory is producing metal for 99% pure or has to keep definite impurities down to less than a fraction of 1%, the spectrograph is likely to be as accurate. In every case it is much quicker.

Other contributions deal with subjects as widely separated as brewing, the refining of sugar, the manufacture of silica ware, the analysis of soil and diseases of sheep. To take the last only, a disease common in Somerset has been shown to be associated with a small trace of molybdenum in the herbage; traces as small as are here important would hardly have been revealed by chemical analysis.

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The Spectroscope is being used in an increasing measure for stndardising vitamins. The spectroscopic requirements for riboflavin have recently been investigated by Dr. H. R. Kreider of the American Medical Association's Chemical Laboratory. Dr. A. E. Ruehle of the Bell Telephone Laboratory has made extensive use of ultraviolet absorption spectroscopy for studying the chemical reactions of vitamin B_1. For the assay of vitamin A the spectroscope offers, perhaps, the best method. Evidence

has accumulated to show that more than one vitamin A occur, all very similar in physiological effects. The existence of these have been revealed by the spectroscope.

A routine list of spectrographic apparatus required for vitamin A assay work in the pharmaceutical or food industries is given in the *Bausch & Lomb Instrument Bulletin*, No. 43 (January 9, 1939). Special problems involved in the spectroscopic analysis of the several vitamins should be referred to Messrs. Bausch & Lomb, Rochester.

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Announcements

J. N. Tata Endowment for Advanced Studies.—Applications for studentships available for advanced study out of India, will be received *not later than the 31st July 1939*, by the Secretary, J. N. Tata Endowment for Higher Education of Indians, Bombay House, Fort, Bombay. Applications should be in the prescribed form which can be had on application from the Secretary, and must be accompanied by copies of testimonials as to character, special aptitude and physical fitness (including eyesight) and a photograph of passport size. Applications of students who have graduated with conspicuous distinction will be considered.

Three studentships shall be given to Parsi candidates for every studentship awarded to a non-Parsi candidate but if eligible Parsi candidates are not available, further studentships will be available to non-Parsi candidates.

The Executive Committee of the **International Union against Tuberculosis** has announced the award of a biennial prize of 2,500 French Francs in memory of the late Prof. Leon Bernard, who was the Founder and for fourteen years the Secretary-General of the Union. The prize will be awarded for the second time in 1940 to the author of an original essay on "Conjugal Tuberculosis" in French or in English. The essays must be typewritten or printed and must not exceed 10,000 words. They must be forwarded to the Secretary, Tuberculosis Association of India, 20, Talkatom Road, New Delhi, not later than March 1, 1940.

The Adult Education Committee of the **Central Advisory Board of Education** in India meets in Simla on July 17, 18 and 19. The Committee which was appointed at the fourth annual meeting of the Central Advisory Board of Education held in New Delhi on December 3, 1938, to examine the problem of adult education in India and to report to the Board, consists of the following members:—

(1) The Hon'ble Dr. Syed Mahmud, Minister of Education, Government of Bihar (*Chairman*); (2) The Hon'ble Mr. Sampurnanand, Minister of Education, Government of the United Provinces; (3) Rajkumari Amrit Kaur; (4) Mr. W. H. F. Armstrong, I.E.S., Director of Public Instruction, Punjab; (5) The Educational Commissioner with the Government of India.

The following have been co-opted members of the Committee:—

(1) The Hon'ble Mr. Varkey, Minister of Education, Madras; (2) Mr. Bhagwat, Chairman, Adult Education Committee, Bombay; (3) Mr. J. J. Ghandy, General Manager, Tata Steel and Iron Works, Ltd.; (4) Dr. W. A. Jenkins, Director of Public Instruction, Bengal.

Agricultural Training at the Imperial Institute of Agricultural Research.—The date for admission to the post-graduate courses of the Imperial Agricultural Research Institute, New Delhi, has been changed from November 1 to October 1 from the next session, according to a press note issued by the Principal Information Officer, Government of India.

Though a research organization at which studies are made of fundamental agricultural problems of general or all-India importance, or of such problems as cannot be properly or conveniently investigated by the Provincial Departments of Agriculture, the Imperial Agricultural Research Institute is also a higher teaching institution, providing post-graduate courses as well as facilities for special research, for selected graduates of Provincial Agricultural Colleges and distinguished science graduates of Indian Universities.

The Third All-India Obstetric and Gynaecological Congress.—With a view to facilitate collection of data relating to the three principal subjects of discussion at the ensuing Congress, *viz.*, (1) Anæmia of pregnancy; (2) Functional uterine hœmorrhage; and (3) Maternity and child-welfare, the provisional scientific committee have formulated a scheme, copies of which can be had on application from Dr. S. Mitra, M.B., Secretary, Provisional Scientific Committee, 3, Chowringhee Terrace, Calcutta.

We acknowledge with thanks, receipt of the following:—

"Journal of Agricultural Research," Vol. 58, Nos. 6 and 7.
"Agricultural Gazette of New South Wales," Vol. 50, Part 5.
"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 4.
"The Nagpur Agricultural College Magazine," Vol. 13, No. 4.
"The Indian Journal of Agricultural Science," Vol. 9, Pt. 2.
"L'Agricoltura Coloniale," Vol. 33, No. 4.
"Biochemical Journal," Vol. 33, No. 4.
"Berichte der deustschen chemischen Geselschaft," Vol. 72, No. 5.
"Journal of the Institute of Brewing," Vol. 45, No. 5.
"Journal of Chemical Physics," Vol. 7, No. 5.
"Journal of the Indian Chemical Society," Vol. 16, No. 3.
"Chemical Age," Vol. 40, Nos. 1034–1038.
"Journal de Chemie Physique," Vol. 36, No. 2.
"Chemical Products," Vol. 2, No. 1.
"Experiment Station Record," Vol. 80, No. 4.
"Indian Forester," Vol. 65, No. 6.
"Forschungen und Fortschritte," Vol. 15, Nos. 13–15.
"Transactions of the Faraday Society," Vol. 35, No. 217.
"Transactions of the Geological, Mining and Metallurgical Society of India," Vol. 10, Nos. 3–4.

attention of Governments in the last few years. It will be seen, for example, that the protection of neglected and delinquent children has made fresh progress in nine countries, and that the small number of countries which inflict corporal punishment on minors has been further diminished, since New Zeland has amended her legislation so as to abolish whipping inflicted by order of the Children's Courts.

"In another direction it will be observed that the United Kingdom has made a bold innovation in the legislative sphere by investing the local authorities of the large towns with the power to close certain streets for traffic at certain hours in order that they may be utilised as playgrounds. The effects of this measure will be felt both as regards the prevention of juvenile delinquency and that of the protection of children against the physical dangers of the streets.

"A number of countries make no distinction between the protection of children and the protection of families. In this connection the Uruguayan law of April 19, 1938, authorising the constitution of "homesteads" and laying down the conditions attaching thereto is a document of great interest."

* * *

Naturalistic Measures in the Control of Malaria.—The latest issue of the *Bulletin of the Health Organization* of the League of Nations (No. 6) is mainly devoted to rural life problems. Drs. Heckett, P. F. Russell, J. W. Schraff and Senor White have discussed in an interesting article, the present use of naturalistic measures in the control of malaria. "In including this problem, the Malaria Commission of the League of Nations had in mind the questions raised by rural malaria in poor countries. The article deals with the first step towards the solution of the problem by critically surveying all action taken so far on naturalistic lines. This is defined as "the deliberate extension or intensification of natural processes which tend to limit the production of mosquitoes or their contact with man". The authors stress the desirability of creating experimental centres and of ascertaining the cost of methods before applying them".

* * *

A study of the Jute apion has been undertaken at Dacca in the Agricultural Research Laboratory of the **Indian Central Jute Committee**. A survey of the low land areas in the Rangpur District revealed that young seedlings were attacked by a number of pests and diseases. The jute apion does not appear to have been previously recorded at such an early stage. To study their life-history, the jute apion and the indigo-caterpillar are being reared in the Laboratory. From the diseased material, species of Rhizoctonia, Fusarium and Alternaria have been obtained.

* * *

The creation of a separate government department in order to undertake research on earthquakes is urged in the Memoir on the Bihar-Nepal Earthquake of 1934, just issued by the Geological Survey of India. The subject is too specialised to be regarded as requiring the occasional attention of the meteorological department and the Geological Survey. The work could be more thoroughly and authoritatively studied by whole-time specialists. There are two lines of investigation awaiting such a department: (*a*) the prediction of future earthquakes as to time and place, and (*b*) the means of minimising their effects. "From a scientific and engineering view-point, the whole of North India within, say, 200 miles of the foothills of the Himalaya, must be regarded as a region particularly susceptible to severe earthquakes". Evidence exists for postulating the constant movement of the Himalaya throughout tertiary times down to the present day, a movement directed laterally towards the peninsula and giving rise to great horizontal thrust planes. On the Peninsula in Chota Nagpur, there has been a succession of upward movements during Tertiary times, giving rise to a general tilting towards the north. In the Gangetic Plains between, there has been constant subsidence. It is believed that all these movements are related. In the downward folded zone of the Gangetic Plains between the two uplifted regions of the Himalaya and the Peninsula, a state of strain or potential fracture is presumed to exist.

* * *

We understand that the Locust Research Scheme of the Imperial Council of Agricultural Research, which has till now been located at Karachi under the Locust Research Entmologist, has now been difinitely closed. In view, however, of the importance of continuing the work of watching the deserts in the Indian area for locust developments and of warning the Indian cultivator about locust invasions in advance, the Government of India have sanctioned, with effect from 1st April 1939, the establishment of a "Locust Warning Organisation" under the supervision of the Imperial Agricultural Research Institute, New Delhi, for which the services of a good part of the staff of the late Locust Research Scheme have been retained. The desert staff is to be controlled by a Superintendent stationed at Karachi.

* * *

The Twenty-first Anniversary of the **Bose Institute** was also the first Memorial Meeting for its illustrious Founder, Sir Jagdis Chandra Bose, who dedicated this Institute to the Nation on his fifty-ninth birthday, November 30, 1917. Sir Nilaratan Sirkar, in his Presidential Address, gives a very interesting summary of Bose's life and work, and points out that the Bose Institute is the "first and foremost among his gifts for the advancement and diffusion of knowledge. ..... This unique Institution, with its potentialities, should form an invaluable asset to the Nation, provided we knew how to utilise it." Sir Nilratan concludes with a quotation from Bose's inaugural address delivered on the Foundation Day of the Institute, a masterpiece of Bose's poetic imagination, literary skill and dynamic philosophy.

Dr. D. M. Bose, the present Director of the Institute, gives an outline of the work now being carried on at the Institute in plant physiology, plant genetics, agriculture, biochemistry, zoology, anthropology, and the chemical analysis of soil, food-stuffs, and the active constituents of Indian medicinal plants. The Physics

Laboratory of the Bose Institute has been enlarged for investigations in spectroscopy, ultrasonics, natural and artificial radioactivity and cosmic radiation. In co-operation with the Departments of Physics and Applied Mathematics of the University College of Science, Calcutta, the Institute conducts a lively Colloquium on Nuclear Physics.

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Mr. P. M. Kharegat, C.I.E., I.C.S., lately Secretary, Industries and Education Department, United Provinces, has succeeded Sir Bryce Burt, C.I.E., M.B.E., I.A.S., as Vice-Chairman, Imperial Council of Agricultural Research.

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The Maynard-Gangaram Prize for the year 1939 has been awarded to Rao Sahib Ch. Ram Dhan Singh, M.A. (Cantab.), Cerealist, Punjab Agricultural College, Lyallpur, in consideration of his meritorious work on the breeding of new wheat varieties.

* * *

Cawnpore Sugar Technology Institute.—The annual report of the Imperial Council of Agricultural Research for the year 1937–38 gives details of the training facilities provided by the Cawnpore Sugar Technology Institute. It will be remembered that the Institute was established by the Government of India in October 1936, on the recommendations of the Tariff Board and the Sugar Committee, for a period of five years. It undertakes research on (1) Problems of Sugar Technology in general and those of sugar factories in India in particular; (2) Utilisation of bye-products of the industry; (3) Detailed testing of new varieties of cane under factory conditions; and (4) General problems of sugar engineering and chemistry.

To meet the demand for specialised technical staff for work in sugar factories, the Institute trains students in all branches of Sugar Technology and Sugar Engineering and arranges for refresher courses for men already employed in industry. In Sugar Technology and Sugar Engineering, a three years' course for the diploma of I.I.S.T. is provided. Graduates in Physics, Chemistry and Mathematics, Mechanical or Electrical Engineering are eligible for admission. Twelve admissions are made each year.

The Sugar Boilers' Certificate course is open to candidates who have passed the Intermediate Examination in Science or any equivalent examination. It is a one-year course; after two years, experience in Pan-boiling, the student becomes entitled to the certificate. Twelve admissions are made each year.

Three admissions are made yearly for post-graduate research in the sugar technology section and three in the sugar engineering section. The course extends to two years during the non-working period of cane factories and two seasons' factory experience after qualifying for the associateship. The diploma of F.I.I.S.T. is the highest Government diploma of Sugar Technology or Sugar Engineering in India.

Arrangements have also been made for short courses on a variety of subjects relating to Sugar Industry for candidates who do not possess the necessary technical and academic qualifications for the higher courses. These include a two sessions' course on Chemical Control and Bacteriology and a one session course on Pan-boiling, Fuel and Boiler control, Statistics (for sugar students), statistical methods (for research students) and training in Dutch and German languages. The sessions are usually held during the sugar off-season, so that actual employees in sugar factories may not be at a disadvantage. The general qualifications required for short courses are a B.Sc. degree with Chemistry, and some practical experience in a sugar factory. A high school leaving certificate is the minimum qualification for a Pan-boiling course, for the course on Statistics (for sugar students), the candidate is required to have passed the I.A. or I.Sc. with Mathematics as one of the subjects.

The Institute grants two scholarships of Rs. 25 per month each, one for the Associateship Course in Sugar Technology and the other for the Associateship Course in Sugar Engineering.

An employment bureau assists the ex-students of the Institute in finding jobs in Sugar Factories.

* * *

University of Mysore.—I. *Lectures*: Under the Scheme of Extension Lectures, Mr. V. L. D'Souza, B.A., B.com., delivered a lecture in English on "Population and Production" at each of the places, Shimoga and Bhadravati.

II. *Meeting of the Senate*: The annual meeting of the Senate was held on the 31st March 1939. Among the propositions that were passed, mention may be made of the following:—(1) Holding the Final Examination for the M.B.B.S Degree twice a year; (2) Removal of the condition of a pass in the Intermediate examination in the case of candidates who hold the L.M.P. Diploma of Mysore and who seek admission to the Pre-Medical Course; (3) Holding the University examinations in future in February and March instead of March and April commencing from 1940, the University session commencing on 1st June instead of on the 24th; (4) Recommendation to the University Council to take necessary steps for affording the University students every opportunity for obtaining Military Training on suitable lines; (5) Recommendation to the University Council for the deputation of two members of the University staff in the cadre of Assistant Professor of English to England for higher studies in English Language and Literature; (6) Recommendation to the University Council for taking all necessary steps for establishing an Intermediate College at a mofussil centre to be selected by the Council; (7) Opening of a 'University Adult Literacy Campaign' in connection with Rural Reconstruction Centre now located by Government at Closepet.

* * *

Enquiry into the Cultivation of Cloves in India.—The subject of this enquiry, *viz.*, cloves, is one of those important agricultural products of commerce about which little is known. It was a welcome attempt on the part of the Imperial Council therefore to have instituted the present survey which not only brings out the very gratifying fact that cloves are already growing in the country and that the conditions of soil and climate in certain parts are quite suitable for its cultivation but also brings

together a comprehensive mass of information bearing on all aspects of the cultivation methods as carried out both in this country and in the more important centres of cultivation outside such as Zanzibar, Madagascar, Ceylon, and the Dutch East Indies (Report of an Enquiry into the Cultivation of Cloves in India by A. K. Yegna Narayan Aiyer, *Misc. Bulletin*, No. 20, Manager of Publications, New Delhi, 1938). An interesting account is given of the great attempts of the old East India Company to introduce the cultivation into India from the Dutch East Indies and thereby break the monopoly which the Dutch enjoyed in respect of this costly and valuable product, in those far off days of the struggle for supremacy in the trade with India and the orient generally. A description is given of the clove groves to be found in India, and for the sake of comparison of the clove groves in Ceylon, the descriptions being illustrated by photographs. The present trade in cloves in India is reviewed, there being an import annually of some 62,000 cwts. valued at about forty lakhs of rupees, though in a peak year the imports rose to over 73,000 cwts. This gives an idea of the scope there exists for local production. The soils of the present clove areas in India and those of the Ceylon areas for comparison have been analysed and these elaborate data form an important feature of the survey. Nursery practices, varietal characteristics, manuring, pests and diseases, harvesting and curing methods are dealt with in detail. With the exception of the fact that at the young stage the plants are delicate and are difficult of establishing, the cultivation appears to present no difficulties. Experimental cultivation on an area of about one hundred acres in the different cligible centres is suggested, as well as a study of various methods of propagation for overcoming the initial difficulties and securing other advantages. It is now up to the Imperial Council to follow up this commendable beginning with definite practical steps for the starting of the cultivation in the centres spoken of as suitable in the Report.

* * *

The Composition and Agricultural Value of the Fine Ejecta of Volcanic Eruptions.—The eruption of the Mayon Volcano in the Philippine Islands in the month of June 1938 was taken advantage of to determine the chemical and physical composition of the ejecta and its agricultural value by N. L. Galvez (*The Philippine Agriculturist*, 27. Nos. 9 & 10). Seven samples were examined, six of which were similar in texture to ordinary soils, while the seventh belonged to that class of ejecta called lava. The chemical composition of the latter was found to be almost identical with the former, which analysed as follows:—SiO_2 56·36, TiO_2 0·78, Al_2O_3 19·37, Fe_2O_3 8·23, MnO 0·4, CaO 8·50, MgO 1·13, K_2O 1·16, SO_3 0·40, P_2O_5 0·56 and loss on ignition 0·72. The lava differed materially from the other ejecta only in the loss on ignition and the Fe_2O_3 contents which were 0·20 and 7·80 respectively. Analysed for their agricultural value, the six samples contained on the average (in the portion soluble in 10 per cent. HCl) among other constituents the following:—Al_2O_3 4·67, Fe_2O_3 1·53, CaO 2·17, MgO 0·20, K_2O 0·07, Na_2O 0·57, P_2O_5 0·10. One of the samples contained a trace of nitrogen while the others, including the lava, contained nothing of this constituent. The insoluble residue was high, *viz.*, 88·76. The amount of available K_2O was low while that of available P_2O_5 higher than for ordinary soils. The fine ejecta is hygroscopic and acidic in reaction and the leaves of abaca (*Musa textilis* Nee) and papaya (*Carica papaya* Linn.) on which the ejecta settled became scorched and wilted, in consequence. Though the samples were all devoid of any nitrogen, they contained (collected two weeks after the eruption) colonies of bacterial growths of moulds and sulphur-oxidising organisms, while nitrifying and azotobacter organisms were absent. A. K. Y.

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Announcements

Seventh World's Poultry Congress and Exposition.—The Seventh World's Poultry Congress and Exposition will be held at Cleveland, Ohio (U.S.A.), from July 28 to Agust 7, 1939. Immediately before and after the Congress, a series of tours to various parts of the country will be arranged for visitors. It is the desire of the General Congress Committee that National Committees be formed as soon as possible by all countries expecting to participate in the Congress. Each National Committee will serve to organize the representation of its country at the Congress and to maintain contact with the United States Organization.

The following five sections will comprise the Scientific Sessions: (1) Genetics and Physiology; (2) Nutrition and Incubation; (3) Pathology and Disease Control; (4) Economics, including Processing and Marketing; and (5) General.

All communications regarding the Congress should be addressed to W. D. Thermohlen, Secretary General, Seventh World's Poultry Congress and Exposition, United States, Department of Agriculture, Washington, D.C., U.S.A.

All-India Obstetric and Gynecological Congress, 1939.—The Third All-India Obstetric and Gynecological Congress will be held in Calcutta in December 1939. The principal subjects of discussion are (1) anæmia of pregnancy, (2) functional uterine hæmorrhage, and (3) maternity and child-welfare. The Provisional Scientific Committee have formulated a scheme to facilitate investigations on these subjects. All communications are to be addressed to the Secretary, Dr. S. Mitra, M.D., F.R.C.S., F.R.C.O.G., 3, Chowringhee Terrace, Calcutta.

A New "Nomenclator Zoologicus."—Professor Julian S. Huxley, Secretary, Zoological Society of London, writes:—The preparation of this work, respecting which an announcement was made in 1935, is now approaching completion. It constitutes an attempt to bring together the names of all the genera and subgenera in Zoology that have been described from the 10th edition of *Linnaeus*, 1758, up to the end of the year 1935, with a bibliographical reference to the original description of each. It will also

include the great majority of alternative spellings that have appeared during that period. Another feature that will, it is thought, be found valuable for systematists relates to cases where a new name has been proposed for a homonym. In these instances a cross-reference is given under the homonym to the new name.

It is estimated that the work will comprise some 225,000 entries, of which about 5,000 appear to have been omitted from all previous publications of this character. It is proposed to publish the work in 4 volumes of nearly 1,000 pages each, which it is hoped it will be possible to issue at intervals of about six months.

The Zoological Society of London has already borne the whole cost of preparation (approximately £1,800), but the Council of the Society does not feel justified in incurring further expenditure in respect of this enterprise, which would involve an additional £3,600.

However, with the aid of various grants from outside sources, the Editor, Dr. Sheffield Neave, has himself now been able to arrange for the printing and publication of the work. It is proposed to publish it at the low advance-subscription rate of six guineas post free for the four volumes, provided that a sufficient number of undertakings to subscribe can be obtained. (Intimation may be sent to Dr. S. A. Neave, O.B.E., Imperial Institute of Entomology, 41, Queen's Gate, London, S.W. 7.) If these are adequate, it is hoped to issue the first volume during the coming summer. After publication, the price will be raised to eight guineas.

Messrs. *The Veritas Press*, Inc., New York, announce that they will soon be publishing a comprehensive Thesaurus of Geology and allied scientific terms, under the authorship of Walther Huebner. The publication, which is the first of its kind in the history of geological literature, will explain and co-ordinate more than 25,000 geological terms in the English and German languages, covering exhaustively all branches of the subject. The price of the book, which will contain about 400 pages, will be $7·50, and the English-German Part is expected to be published in October 1939.

Considering the nature and scope of the work we have no doubt that this compilation will be welcomed, and its value appreciated, by geologists all over the world, who wish to be familiar with English and German geological literature.

Messrs. *Annual Review*, Inc., Stanford University, P.O. California, announce that the *Annual Review of Biochemistry*, Vol. VIII, 1939, will be ready by July 15, 1939. The volume will contain approximately 680 pages and is priced $5·00 per copy.

The non-profit Bibliofilm Service (*Bibliofilm Service*, U.S. Department of Agriculture Library, Washington, D.C.) copies, at cost, for serious research workers, extracts from almost all publications, except certain of those which are copyrighted) abstracted in *Chemical Abstracts*. Present rates are 1 cent per page plus a fixed service charge of 20 cents for copying in the form of microfilm (35 mm. standard safety photographic film conveniently usable in reading machines now widely available at moderate cost), or 10 cents per page, plus service charge of 20 cents, for copying as photoprints 6″ × 8″, readable without optical aid). When properly copyable material is not available in the four great scientific libraries where Bibliofilm Service has installations, it is usually borrowed from other institutions for copying, or copies through other services or in other cities at their somewhat varying rates (*Chemical Abstracts*).

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We acknowledge with thanks, receipt of the following:—

"Agriculture and Live-Stock in India," Vol. 9, Pt. 2.

"Journal of Agricultural Research," Vol. 58, Nos. 3–5.

"Agricultural Gazette of New South Wales," Vol. 50, Pts. III–IV.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 30, No. 3.

"Biochemical Journal," Vol. 33, No. 3.

"Berichte der deutschen chemischen geselschaft," Vol. 72, No. 4.

"Journal of the Institute of Brewing," Vol. 45, No. 4.

"Journal of the Indian Botanical Society," Vol. 18, No. 1.

"Biological Reviews," Vol. 14, No. 2.

"Communications from Boyce Thompson Institute," Vol. 10, No. 2.

"The Journal of Chemical Physics," Vol. 7, No. 4.

"Journal of the Indian Chemical Society," Vol. 16, No. 2.

"Chemical Age," Vol. 40, Nos. 1030–1033.

"The Calcutta Review," Vol. 71, No. 1.

"Chemical Products," Vol. 1, No. 6.

"Experiment Station Record," Vol. 80, No. 3.

"Indian Forester," Vol. 65, No. 5.

"Forschungen und fortschritte," Vol. 15, Nos. 10–12.

"Transactions of the Faraday Society," Vol. 35, No. 216.

"Genetics," Vol. 24, No. 2.

"Bulletin of Health Organization (League of Nations)", Vol. 6, No. 6.

"Calcutta Medical Journal," Vol. 35, No. 5.

"Bulletin of the American Meteorological Society," Vol. 20, Nos. 1–2.

"Scripta Mathematica," Vol. 5, No. 4.

"Journal of the Indian Mathematical Society," Vol. 3, No. 5.

"Indian Medical Gazette," Vol. 74, No. 4.

"Nature," Vol. 143, Nos. 3621–3624.

"American Museum of Natural History," Vol. 43, No. 4.

"Journal of Nutrition," Vol. 17, Nos. 3–4.

"Proceedings of the Royal Netherlands Academy", Amsterdam, Vol. 42, No. 1.

"Indian Journal of Physics," Vol. 12, Pt. VI.

"Canadian Journal of Research," Vol. 17, No. 2, A, B, C and D.

"Research and Progress," Vol. 5, No. 3.

"Journal of the Royal Society of Arts," Vol. 87, Nos. 4505–4508.

"Sky," Vol. III, No. 6.

"Indian Trade Journal," Vol. 132, Nos. 1712–1714.

ACADEMIES AND SOCIETIES

Indian Academy of Sciences:

April 1939. SECTION A.—R. S. KRISHNAN: *Influence of Secondary Scattering on Depolarisation Measurements.* The secondary scattering which is very pronounced in emulsions and proteins enhances the values of ρ_H, ρ_V and ρ_h. This effect can be eliminated by using a very narrow pencil of light for illumination. M. AFZAL AND V. I. VAIDHIANATHAN: *A note on Capillarity and Subsoil Water-Table.*— A large number of concave menisci formed in the interstices near the surface exert a negative pressure, and hold down the subsoil water level. S. BHAGAVANTAM AND CH. V. JOGA RAO: *Ultrasonic Velocity and the Adiabatic Compressibility of some Liquids.*—The adiabatic compressibility derived from ultrasonic velocity and determined directly on the same specimens of liquids, are found to be in good agreement. B. RAMAMURTI: *A Special Net of Quadrics.* BAWA KARTAR SINGH: *The Space Arrangements of Atoms—Part I. The Configuration of Nitrogen in the 3-Covalent State.*—It is deduced from stereochemical considerations that the nitrogen valencies are non-planar. S. RANGASWAMI, T. R. SESHADRI AND J. VEERARAGHAVIAH: *Constitution of Naringin.*—The position of the sugar group. Glucose and rhamnose exist as a disaachraride unit attached to position 7. G. R. PARANJPE, Y. G. NAIK AND P. B. VAIDYA: *Scattering of Light by Large Water Drops. Part I, and Part II.*—Mie's theory has been extended to larger sizes of particles of radius varying from 0·4μ to 3·0μ. The corresponding experimental studies on steady clouds confirm the calculated angular distribution of intensity and its dependence on the particle size. P. SURYAPRAKASA RAO AND T. R. SESHADRI: *Pigments of Cotton Flowers. Part VIII.—Constitution of Herbacitrin and Quercimeritrin.* Herbacitrin is the 7-glucoside of Herbacetin and Quercimeritrin in the 7-glucoside of Quercetin.

April 1939. SECTION B.—B. N. SINGH, K. N. LAL AND M. B. LAL: *The Influence of Artificial Fertilisers upon the Photosynthetic Efficiency of* Andropogon Sorghum. B. N. SINGH AND S. R. A. N. RAO: *Photosynthetic Efficiency of Leaves as Influenced by Variations in pH of the Injected Solutions.* K. BHASKARAN NAIR: *The Reproduction, Oogenesis and Development of* Mesopodopsis orientalis *Tatt.* B. R. SESHACHAR: *On a New Species of* Uræotyphlus *from South India.*

Indian Chemical Society:

February 1939.—J. C. GHOSH: *The Production of Optically Active Substances and Metallic Films of Silver, Platinum and Palladium by means of Circularly Polarised Light.* TEJENDRA NATH GHOSH AND DEBABRATA DAS-GUPTA: *Pyrazole Derivatives.* S. K. RANGANATHAN: *-isoPropylglutaconic Acid.* V. S. PURI AND V. S. BHATIA: *The Action of Inorganic Colloids on Electrodeposition of Nickel.* B. N. GHOSH, P. K. DUTT AND D. K. CHOWDHURY: *Enzymes in Snake Venom—Part V. Detection of Dipeptidase, Polypeptidase, Carboxypolypeptidase and Esterase in Different Snake Venoms.* S. G. CHAUDHURY AND M. K. INDRA: *On Theories of Adsorption Indicators.* SURESH CHANDRA SEN-GUPTA: *Studies in Dehydrogenation—Part III.* BALWANT SINGH AND SOHAN SINGH: *Potentiometric Studies in Oxidation-reduction Reactions—Part V. Oxidation with Potassium Chlorate.* U. P. BASU AND S. J. DAS-GUPTA: *Acridine Derivatives as Antimalarials—Part II.* S. K. RANGANATHAN: *Experiments towards the Synthesis of Physiologically Active Lactones—Part I. CycloPentyl- and CycloHexylsuccinic Acids. Resolution of* dl-cyclo*Pentylsuccinic Acid.*

Indian Botanical Society:

April 1939.—H. G. CHAMPION: *The relative stability of Indian vegetational types* (Presidential Address at the 18th annual meeting of the Indian Botanical Society at Lahore, January 1939). C. V. KRISHNA IYENGAR: *Development of the embryo-sac and endosperm-haustoria in some members of Scrophularineæ II.* Isoplexis canariensis, *Lindl and* Celsia coromandeliana *Vahl.* M. J. TIRUMALACHAR: *Grafting of Figs.* K. R. RAMANATHAN: *On the mechanism of spore liberation in* Pithophora polymorpha *Wittr.*

Meteorological Office Colloquium, Poona:

March 3, 1939.—DR. K. J. KABRAJI: *A summary of work on droplet sizes in mountain fogs at Khandala and of conclusions therefrom. March* 10, 1939.—MR. J. M. SIL: *Vaisala's Radiometeorograph.* DR. K. R. RAMANATHAN: *Thomas's Radio-meteorograph. March* 16, 1939.—DR. L. A. RAMDAS: *Some Problems on Radiation. March* 31, 1939.—MR. M. P. VAN ROOY: *Climate of South Africa. April* 21, 1939.—S. P. VENKITESHWARAN: *Bureau of Standards Radio-Meteorograph.*

Society of Biological Chemists, India:

February 18, 1939 (Bangalore)—G. NARASIMHA MURTHY: *Electrical Mobilities of Red Blood Carpuscles in Laboratory Animals during Malnutrition.* Y. V. S. MURTHY AND Y. V. S. RAU: *Calcium and Phosphorus Availabilities in Rice.* P. M. N. NAIDU: *The Test-tube Chick.*

(91-39—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by B. N. Sastri, M.Sc., A.I.C., A.I.I.Sc., for the Board of Editors, "Current Science", Bangalore

With the Compliments of "Current Science"

SIR RICHARD GREGORY, Bt., D.Sc., F.R.S., LL.D., F.R.Met.Soc., F.Inst.P.